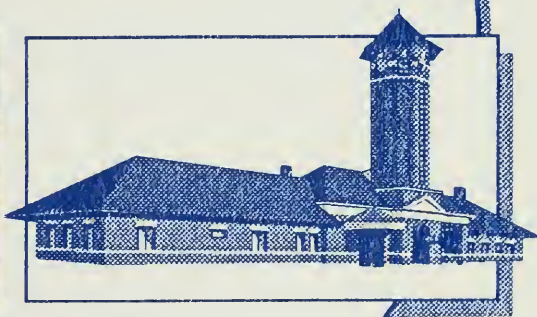
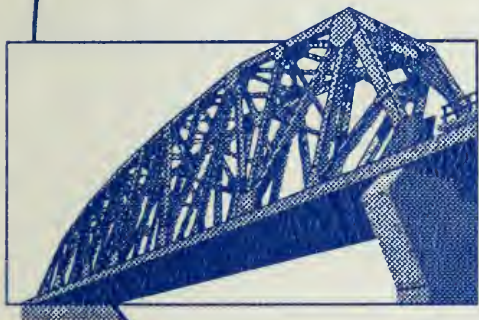


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**AMERICAN RAILWAY
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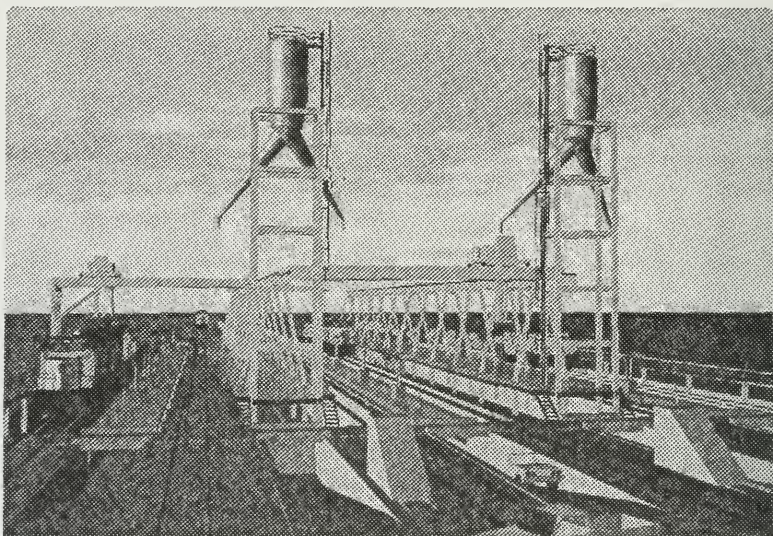
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OF THE

**American Railway
Bridge & Building
Association**



Held at the
COLORADO CONVENTION CENTER
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September 20-22, 1993

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PROCEEDINGS

Monday, September 20, 1993

Opening Joint Session

President Welch: As president of the Roadmasters and Maintenance of Way Association of America and on behalf of Paul Saletnik, president of the American Railway Bridge and Building Association, I declare the annual concurrent conference of the Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association in conjunction with REMSA Technology 2000 and including the AREA Fall Conference, Committee 32 Computer Symposium and TRB Workshop to be open and in joint session.

It is proper at this time that we pause and ask for divine guidance and inspiration prior to commencing with this conference. I would like to call on Karl Sutherland, past president of Roadmasters, to give our invocation. Karl.

Mr. Sutherland: Shall we stand as we ask for Our Lord's blessing. Father in Heaven, we have come to you this morning as we gather together to open this conference. We pray, Lord, that you bless the renewing of old friendships and grant that we may develop new ones.

For those who are attending this conference from other nations of the world, we are very grateful and we pray that lasting friendships may be established with them so that in some small way we may have a part in bringing forth peace that is so desperately needed in our world today.

We seek your presence throughout this conference and we ask for your guidance and blessing of each one attending and may your presence guide, strengthen, and lead all the speakers who will be with us each day. Give them encouragement and confidence during the presentations as we have all come to share experiences and learn from our peers.

May the business of the day be conducted in spirit of the great amongst us. As we ask these things of you this morning, we are ever mindful of your past blessings for which we are eternally grateful. We thank you, Father, for the safe journey to Denver and may your watchful care continue over all of us until we return to our homes. We ask these things in Jesus' name. Amen.

President Welch: Thank you, Karl. At this time, I would like to introduce the officers and directors of the Roadmasters and Maintenance-of-Way Association. Before I do that, I have a special thanks that I don't want to wait until Wednesday to give and that goes to the Southern Pacific Railroad for all the work they have done at the 7th Street Yard and particularly to Ray Hernandez, who is one of our past presidents. Without the Southern Pacific and what they have been able to do for us in Denver and particularly Ray's efforts, we would have probably been several weeks behind where we are today. Ray, thank you very much and we thank the Southern Pacific.

As I introduce my directors, I would like each of them to stand and just walk up in front of the podium, and if you will, hold your applause until we have introduced all of them.

Our first vice-president is Gene Schubel, assistant manager engineering, Burlington Northern. Second vice-president is Keith Nordlund, Keith is project manager, Canadian National. Our immediate past president is Stephen Hill, assistant division manager - engineering, CP Rail. Our treasurer is Kendall Koff, engineer of maintenance, Frederic R. Harris and Southern California Regional Rail Authority.

Our directors are Herb Clark, director of track standards and quality assurance, Chicago and North Western; Jim Young, assistant chief engineer production, Southern Pacific; Ron

Poulsen, director of construction, Union Pacific; Wayne Russell, general director roadway maintenance and planning, Santa Fe; Ray Brosseau, supervisor program maintenance, CP Rail; Dave Smoot, executive vice-president, Indiana Hi-Rail; and Darrell Cantrell, manager service agreements, Burlington Northern. Darrell is also our program chairman for the conference so please be soft with him all week when you see him. He is a little on edge, but I know he is going to pull this off just fine.

Continuing with our directors is Ken Johnson, assistant division engineer, CSXT; Dave Kelly, vice-president and chief engineer, Illinois Central Railroad; Al Cloutier, assistant division engineer, Amtrak; Reuven Shiloh, director of engineering planning and support, Conrail; and Pete Murgas, engineer procedures and administration, Norfolk Southern.

These guys have worked diligently all year and I'm sure you are going to see the benefits of their efforts this week. They are a great bunch of guys. If you will. (Applause)

I will now turn over the podium to Paul Saletnik, president of the B&B Association.

President Saletnik: Thank you, Ken. On behalf of the American Railway Bridge and Building Association, I welcome you all.

I am now very proud to introduce to you the officers and directors of the American Railway Bridge and Building Association. These are the men who work behind the scenes all year long to make the next few days possible. We owe a great debt of gratitude to them for the fine job they have done. As I introduce each of you, I would ask you to come around to the front of the podium and stand and face the audience. If you would, please hold your applause until after all are introduced.

First is senior vice-president, Don Steele, manager bridge construction, Union Pacific; junior vice-president, John Van Huis, chief engineer of structures and production, Wisconsin Central; junior vice-president, Mike Bradley, project engineer, Conrail; immediate past president, Mark Walbrun, project manager Chicago Union Station, Amtrak; and treasurer, Don Lewis, bridge construction engineer, Illinois Central, who is also a past president of the Association.

Directors are Don McCammon, formerly with the Burlington Northern and now office engineer with Howard, Needles, Tammen and Bergendoff; John Creighton, who is unable to be with us today, B&B master, CP Rail; Johnny Bradley, assistant division engineer, Norfolk Southern; Bob Carter, general B&B supervisor, Burlington Northern; Carl Young, project engineer, Conrail; Dave Franz, bridge engineer, Kansas City Southern; Lee Hostler, structures engineer, Santa Fe; Jimmy Neece, B&B supervisor, CSX; and Ron Kaye.

Gentlemen, I wholeheartedly thank you for the work you have done to make this conference possible. (Applause)

At this time I would like to introduce Mr. Chuck Burroughs, president of the AREA and chief engineer of the Southern Pacific. Chuck

Greetings from AREA

Mr. Burroughs: I want to take a few moments here as chief engineer of Southern Pacific. Thanks, Ken, it has been a challenge and a good opportunity for Southern Pacific to share in some of the activities of this glorious time. As chief engineer, I want to welcome you all to Denver. As president of the AREA, I want to welcome you all to this golden opportunity of cross-functional opportunities to share with all of the Associations as well as the REMSA exhibits. I feel this is going to be one of the greatest conferences that there ever was.

Just quickly, the AREA Fall Conference is being held in conjunction with the Roadmasters and B&B annual concurrent technical conference. We will convene this afternoon in this room at approximately 1:15. We will be touching on some of the latest features coming from the FRA, TGV, UP's Hastings Bypass, some of the events here in Denver with light rail, some of the experiences of bridges, and some of the insights as to how Santa Fe and UP in particular contended with the flooding here this summer.

Once again, I want to welcome you all to a great conference. Have fun, learn a lot and we will see you a little later. Thank you. (Applause)

President Welch: Thank you, Chuck. I would like to now introduce Jerry Hines, president of REMSA.

Greetings from REMSA

Mr. Hines: Thank you, Ken. I could spend all of my allotted time just thanking the many people who have helped us put together what will be the most successful REMSA show and joint technical conference ever held. Yet as REMSA president, I have to name a few of the most helpful. Glen Michael, Chuck Burroughs, Bill Van Hook, who is not present as I believe he is moving to Denver; and Ray Hernandez. They are all from the Southern Pacific and I want to thank them. Roadmaster president, Ken Welch, B&B president, Paul Saletnik, the board, and the board secretary, Pat Weissmann and, again, AREA president, Chuck Burroughs. Mike Franke, Santa Fe vice-president, furnished advice and support as did Stan McLaughlin of Union Pacific.

What would I have done without my own hard-working board and our most able executive director, Judi Meyerhoeffer. We just wouldn't be here today without the help of Judi and I wish she were here so we could give her a round of applause. If you guys happen to see her running by, I would really appreciate it if you would stop her and thank her for all her work because she is the basic continuity between the REMSA board and everything that we are trying to do on the outside. She has been a great help.

When I got elected to the REMSA executive board about five years ago, I probably should have done a little better math because Ken Norton would probably be up here right now. Seriously, these three days are what I have worked on all year and still we have made some mistakes. Yes, and I said, "we," meaning the REMSA board.

We should have had the train trip to Pueblo of which I'm sure most of you are aware. We got all hung up on insurance and what ifs and decided in July at our board meeting in Chicago to cancel the trip. Lots of rumors went flying around that other people made the decision, but it was the REMSA board that made the decision. It was not the decision of the railroads. In fact, they were very cooperative.

I am the president of REMSA and you can blame me for the lost train trip only if you praise me for the multi-million dollar equipment show that you are about to see. (Laughter)

To you railroaders who are first timers to the REMSA equipment show, welcome. REMSA worked really hard in our advertising in order to get you here. Now, to the good old boys. If you would indulge me for a moment, I would like to give a little history of the REMSA organization.

The Railway Engineering Maintenance Supply Association is the oldest organization of its kind. Out of our 270 plus members, there are 170 plus member companies here to display their products and services to you, our customers. Our REMSA organization, like the Roadmasters, B&B, and AREA, has a long service history. We have 28 years this past year under the REMSA name and an additional 73 years from predecessor organizations from which we grew. That's over 100 years of tradition. Though the railroads themselves go back a bit further, we think that REMSA and its member companies have paid their dues and are now an integral part of this great industry.

The purpose of our organization briefly is to promote the welfare of the railroad transportation industry. We accomplish this support through education, lobbying activities, and promotional efforts both inside and outside of our industry. Within our industry as you will see and hear over the next couple of days at the convention center and the Southern Pacific 7th Street Yard, REMSA has and will continue to interact with Roadmasters, B&B, AREA, AAR, and RPI, just to name a few.

Twice-a-year meetings have recently been scheduled by the acting four presidents of

Roadmasters, B&B, AREA, and ourselves to ensure a unified effort is made to achieve common industry goals. Perhaps the most important of these issues today is the need to support CRASH, Citizens for Reliable And Safe Highways. REMSA stands firmly behind the railroads on this issue and will do all it can to convince the general public that safe highways and fair competition in the transportation marketplace are our right. As President Welch has already told you, we will start Tuesday at 7:30 a.m. hearing more about CRASH.

REMSA and its member companies willingly place themselves in the forefront of our industry in order to meet these renewed challenges. Our industry has changed dramatically in the past 20 years and both maintenance departments of the railroads and ourselves, your suppliers, have had to adjust. It has been painful, yet necessary, and isn't it interesting that the news today is limited to the problems of the auto, commuter, trucking, waterway, and airline industries, not the railroads. Our industry should be proud that we have achieved the lean and mean operating position long before these other industries realized it is the only way to operate if we are going to grow and prosper into the next century.

Recently Time magazine brought this point to the general public. I'd like to recount some of the points mentioned and let us all take pride in their observations and at the same time rededicate ourselves to the need to stay on this leading edge.

I quote, "In any given 24 hours, there are 20,000 freight trains moving somewhere carrying 37 per cent of the products our country produces and consumes. The 12 great freight routes which bear 90 per cent of the business of the 535 surviving railroads are all profitable. They make up a \$27.5 billion industry and that nets \$1.95 billion."

The article continues by saying, "The railroads are emerging from a century and a half of troubled times including regulation by the government. Customers are gathering economic force destined to get stronger in a transport picture dotted with troubled ships, planes and trucks." This emergence, as we all know, has been achieved since deregulation through our dramatic downsizing of the major freight routes balanced by the inception of 410 short lines. Railroads have been recognized as the best transportation mode for a market spurt and entrepreneurial investment and subsequently profit. Statistically, employment in your industry has been reduced by half and operating rail lines reduced by a third since this time. Yet, we now move 40 per cent more freight with 40 per cent fewer cars.

As your suppliers, we have had to change in similar ways during this transition. REMSA member organizations have responded to these increased efficiencies and greater demands placed on the track structure by developing, improving, and supplying the railroad industry with products to meet these increased demands. We are all aware of the buzzwords such as quality, lower life cycles, safety, EPA or evergreen purchasing agreements and re-engineering. These became buzzwords because the concepts worked.

We as suppliers have responded to your increased demands. Maintenance-of-way equipment manufacturers have responded to your specific needs of quick on-off track equipment to deal with the shorter track time windows and an increase in production and an increase in operator mechanic efficiency and most importantly, we do it economically, safely, and with the highest quality tools available. Although the strength of today's track force is founded on the forefathers' axiom of dedication and hard work, we have become the high tech business.

REMSA companies are in business to supply you with equipment, tools and materials that, while utilizing the old axiom, meet today's demands for high tech with safety and quality built into the standard components. Track material manufacturers have also responded to your demands specifically with the advent of the premium track components such as premium rail and turnouts, resilient track fastening systems, sounder ballast and a new generation of cross-ties.

The short line railroads have different demands and REMSA's close association with these customers has provided this growing market with specific products to allow the short line to maintain its track and run a profitable railroad. This has been done through the offer-

ing of full service turnkey contracting by REMSA member companies when a short line faces large out-of-face track rehabilitation and providing small non-capital intense tools and equipment for the occasional and every day maintenance work. These examples such as improved quality, product performance, and service are how REMSA members have contributed to lowering your life cycle costs and maintaining your profitability.

However, one word of caution here. It would be a mistake for you, our customers, to achieve these results from us at our expense. We also must have the right to maintain our profitability. This can and will only be accomplished by continuing to work closely and honestly together. REMSA represents true believers in a free-market economy and we know that only the strongest will survive. However, allow those that can survive to be healthy companies and continue to supply you.

The Time magazine article further alludes to our industry when it states that, "Few people these days dispute that railroads are better for the environment. They give off only one-tenth to one-third the pollutants emitted by the trucks. The freight railroads' accident fatality rate per ton mile is a third of that of the trucking industry's. Virtually all the rights-of-way are owned and maintained by the railroads. The battered public highways used by trucks are constantly behind the maintenance curve. These facts can only be looked at by both supplier and railroader as opportunities for our future."

REMSA is committed to being a major force in the railroad's track maintenance success. We will and must continue to devote portions of our revenues to research and development. Once again, however, this should not be a one-way street. You customers must be willing to join with us in protected ventures to develop the products that will increase your efficiency and our efficiency in producing these products. This mutual R&D will cost dollars. However, the shared expense will certainly be less of a burden for us both than it would be for either of us if we went it alone.

Along these same lines, the world railroad industry is now interested in entering into a privatized free market economy. Who better to lead them to the profitable position than the industry who has and hopefully will always be based on providing a great service at a reasonable profit. Our industry, both railroad and supplier, knows how to railroad. We do far more for less than any other industry. The major freight roads are already capitalizing on this opportunity with the Burlington Northern in Argentina and Russia, the Wisconsin Central in New Zealand, and the Canadian National and Conrail also in Argentina. There are also some discussions taking place between some North American railroads and British Rail.

As you enter into these new markets, we hope you will carry our members' products with you and hope you will allow us to manufacture the specific new products that may be needed to address the demands of these situations. As Ross Perot has stated, 'Let's keep the jobs in America.' In this case, America is North America. Our Mexican and Canadian members represent an important cog in the wheel of our industry and together this future can be bright for all of us.

Finally, the article concludes by stating, "The American freight railroads have the capacity to carry three to four times the freight they carry today." Isn't that what I heard AAR president Harper tell Congress? This is an exciting invitation for action in this dynamite railroad industry's future. It cannot be said any better than that.

REMSA and its member organizations pledge their support to you to do what it will take to bring this business back to the railroads where it belongs. As you visit the booths and the outdoor exhibits this week, let's all keep focused on what great opportunities there are for our industry as we approach the next century.

I would just like to say thank you to the employees of Orgo-Thermit who have had to put up with me for the last six or seven months and a special thanks to Mark Schwartz and Vin Terrill. Thank you. (Applause).

President Welch: At this time I am happy to introduce Stan McLaughlin, vice-president

of engineering for Union Pacific Railroad in Omaha. Stan is a very good friend of all of our associations and I'm sure most of you know him. He has been involved with all of our associations and I don't think we could ask for a better friend.

Stan has direct responsibility for all the design, construction, and maintenance of the Union Pacific's tracks, bridges, signals, and other fixed facilities. Stan obtained his Bachelor of Science degree in civil engineering from the University of Nebraska and his Masters degree in management from the Massachusetts Institute of Technology in 1983. He began his career with Union Pacific as a staff engineer in 1971 and then has moved up through numerous field positions over the years. In August, 1985, he was appointed chief engineer of the Union Pacific and assistant vice-president in January, 1986. As assistant vice-president, he was over both the Missouri Pacific and the Union Pacific prior to the final merger.

Stan is a member of the Roadmasters' Association, the American Railway Bridge and Building Association, and the American Railway Engineering Association, of which he served as president from 1988 to 1989. He also served as chairman of the AAR engineering division general committee. Stan is an honorary member of the University of Nebraska chapter of civil engineering honor society and is a registered professional engineer in Nebraska, Kansas, Colorado and Wyoming.

It gives me great pleasure to introduce Stan McLaughlin. (Applause)

KEYNOTE ADDRESS



Stanley J. McLaughlin
Vice-President – Engineering
Union Pacific Railroad Company

Good morning. It's good to be back. Two years ago, I was fortunate to speak to you when John Horney was president of the B&B Association. I always enjoy being at these conferences. When I last spoke to you, I said much about Union Pacific's commitment to safety and the improvement that engineering had achieved. Since then we have continued our trends and I will update you on that in a moment.

We have also made great progress in our quality program. Ken Sito and Windell Pyles will be speaking to you about quality later this morning and I don't intend to steal their thunder.

However, both our quality process and our safety process have two common ingredients and they are management commitment and employee involvement. Let's look for a moment at our continued progress in the area of safety. In 1988, we in engineering recommitted ourselves to the safety process. That process was one that would reinforce an attitude that safety truly is of the first importance among all engineering employees. To achieve this attitude required two primary ingredients. First, management's commitment to provide a safe work environment. This means we constantly look for ways to provide a risk-free workplace. This often means we have to buy better equipment or we may have to change and improve work procedures. It may however mean we have to make physical improvements to our fixed plant.

We consider the wellness of our workforce as a key part of our work environment. We conduct physical exams for our system gang employees on a periodic basis to ensure that our employees are physically fit to work. We have furnished fitness cars for several of our larger gangs and have a network of physical fitness facilities system wide for our employees to use.

A healthy employee is less likely to get injured.

Secondly, and very important, is employee involvement. Our employees see the management commitment and are involved in the process. We utilize employees to work on what we call work environment teams. These teams work on local problems. They identify the problem, come up with the solution and implement the fix without intervention from us in Omaha. We use more formalized management coordinated QI teams to solve systemic problems. We utilize our employees to help us set standards. I'm referring to both safety standards and work process standards. Our employees do the work and they usually know the best way and the safest way to get the job done. They set standards regarding proper tool selection and personal protective equipment. Management reviews, approves, and supports these standards and shares in the responsibility for implementation and uniform enforcement. Our results have been very gratifying. They did not come quickly but they came after we showed that we really had committed ourselves to this on-going process.

Our FRA reportable injuries per 200,000 man-hours dropped from roughly 16 in 1988 and 1989 to 4.9 today. That's a 66 per cent improvement over a five-year period. This year we are showing a 20 per cent improvement over last year's results. The biggest success story involves our large system track gangs such as rail, tie, and surfacing gangs. These gangs have improved their FRA reportables for 200,000 man-hours from approximately 18 in the 1980s to two in 1993.

At Union Pacific, the safest place to work is on a system gang. Our quality process mirrors our safety process. It is based on our commitment to basic principles of problem solving. We identify the problem. We analyze the data. We develop alternative solutions. We choose the appropriate solutions. We implement the plan and we continue to evaluate the results and standardize on the solutions.

Beyond these basic problem-solving principles, the driving forces in our quality program are again management's commitment and employee involvement. In 1992, we recognized that training of our directors motivated them to get involved and to personally support their employees' involvement in the quality program. We then committed to start at the top and train all of our engineering managers in problem solving and quality principles. This training has taken place and 44 per cent of our top engineering managers have attended classes right alongside the track, bridge, and signal employees.

As a result of management's commitment and involvement, we have seen continued across-the-board improvement in our quality efforts and most noticeably an eager involvement by our employees has surfaced. Employee involvement in our quality program has now reached over 2,600 employees. That's approximately 70 per cent of our system engineering forces working on quality or work environment teams. Some of them are working on safety issues. Some of them are looking at productivity issues and some of them are looking at failures in our processes which cost us money. Over 1,000 of the employees and managers have had in-depth training on problem solving and team dynamics to support the QI effort.

As a result of the management commitment and the employee involvement, we are seeing very promising results. We continue to see improvement in safety as a result of our QI teams. We have approved the redesign of numerous products and tools to improve both safety and productivity. In fact, we have reviewed over 100 specific employee-driven recommendations. Many of them have already been implemented and others are currently being evaluated. Our ability to obtain these results are primarily due to the fact that we are committed and we are involving all of our employees in the process.

This is perfectly parallel to the safety efforts. I wanted to point out these parallels because of the success we are having and because I believe that the maintenance challenges which our industry faces can only be addressed through similar cooperative relationships between everybody involved with the engineering and maintenance professions.

I will give you a good, current example of this cooperative effort. During the last two

years, increased pressures have been placed on the AAR to be more cost effective in representing all of the railroads. This has meant the downsizing of the AAR at the same time that the demands on the AAR have increased. Sound familiar? The leadership at all of our railroads have, in turn, asked the AAR to look at all of the support organizations within the industry to ensure that they bring value to the industry itself.

In 1992, the AREA underwent some difficult self analysis and made some changes in committee structures as a result of that analysis. During 1993, both the Roadmasters Association and the B&B Association went through similar self analysis. Both organizations have come through the process with renewed commitment to provide value to the industry. As a result of the reviews, the Roadmasters' Association, B&B Association, AREA and REMSA have signed a formal letter of understanding to work even closer during the years to come. It is the intent of all four organizations to identify duplication and eliminate it and to identify industry voids and fill them. It is this spirit of cooperation which must prevail if we are to obtain the gains in the engineering and maintenance-of-way professions necessary to adequately support the business growth in our industry.

I mentioned that REMSA has also signed the letter of understanding among our professional organizations. It is also noteworthy that this year's REMSA equipment exhibits are entitled Technology 2000. Dramatic changes have occurred in track maintenance methods, materials and equipment over the last decade. However, these advances must continue into the next century. Similar to the quality process and the safety process, this can only be accomplished through a renewed commitment by the leadership of our railroads and by the involvement of our maintenance professionals.

REMSA cannot be asked to produce equipment that will meet our needs if we don't adequately define what our needs are. Those needs can be defined very broadly by railroad leaders but must be further defined by you, the professionals closest to the work. You, in turn, must involve your employees to understand in the greatest detail what their needs are. They will tell you what they need to do the job safely and effectively if you involve them in the solution.

Union Pacific is committed to our internal processes and we are equally committed to supporting similar processes within the industry. Throughout the last two years of organizational analysis, UP has been committed to the need for effective professional organizations. We support these organizations because we believe we get a return on the investment that we make. However, we want more. I believe the way to get more return is through meaningful involvement in the organization by all of its members. The power of any organization, whether it is a railroad or a professional organization, rests with the members of that organization. The leadership can commit objectives and strategies. They have the authority to do so. But they don't have the power to accomplish these objectives. The real power is in the hands of those individuals who do the work.

You have all heard about employee empowerment. Employee empowerment is nothing more than an understanding by management that employees know and understand their job and a commitment to let them be involved in defining the details of carrying out that job. I challenge all of you to exercise your power within your respective organizations. While you are here, you should make your presence known. Help your suppliers understand your needs. Share your successes with your counterparts from the other railroads. Ask the many experts who are present the hard questions. Through your questions they will have to stretch and will have to understand your problems just a little bit better.

Another way to get more out of our organizations and ourselves is through more cooperative efforts. Over the past several years, we, at Union Pacific, have developed strong relationships with many of our suppliers. These have been positive for us and positive for our suppliers. Through long-term contract commitments for products, we have allowed our

suppliers to better schedule their production lines. This has yielded them a more stable workforce. A stable workforce has improved their quality and that helps UP. These relationships also allow our suppliers to spend the needed funds for development knowing that they have a revenue stream which will support such expenses.

Again, the research and development expenses by our suppliers ultimately pay dividends to Union Pacific. We have found these relationships to be very good for both Union Pacific and the suppliers involved. However, we think they are also good for the industry because we tell all of our suppliers that they must produce a better mousetrap if they plan to dethrone the current preferred provider. The thought that they, too, might have such a relationship is a powerful motivator for the competition. We don't close out the competition. We invite them in to compete heads up. We believe relationships like these are positive for the industry. We would like to see additional positive relationships established between other partners.

Why don't each of our railroads share more? Currently Union Pacific and CSXT have worked out a mutually positive relationship for the sharing of the P-811 track laying machine. Up to now, neither of the roads could afford to commit to full-time use. However, we both had long-term needs for the equipment. Working with the supplier, we each schedule our projects recognizing a predetermined commitment to release the equipment to the other road. Further cooperation between multiple railroads and the supply industry can increase utilization of existing equipment making suppliers more viable and making the cost of the equipment more affordable to us all.

Is there any reason the various railroads cannot share our training capabilities more effectively? Burlington Northern currently trains welders from several roads at their Overland Park training facility. We should be doing more of these kinds of cooperative efforts. For each road to continually reinvest in areas where others have already paved the way and may have the capacity which could be available for the industry's benefit is really silly.

I have listed a few areas where cooperative efforts already exist. We need to do more of it. The recent floods which could have brought much of the industry to its knees showed a glowing example of cooperation between the railroads. In the face of possibly the single largest natural disaster the industry has ever faced, our roads teamed up to make the best use of all of our lines. We were able in a matter of days and even hours, to establish workable relationships.

Although all of the roads involved incurred heavy damage, we all recognized that for the good of our customers and the good of the industry at large we must work together. If any good comes out of such a disaster, it will likely be that we now have a better appreciation for each other and perhaps we have established a certain degree of trust.

Under normal working conditions in our industry, we have shown time and time again that it is terribly difficult to work together to establish relationships that will help each railroad. I cannot make such statements without recognizing that many of our railroads are competitors and that we must be aware of federal anti-trust laws which limit our relationships. However, in the technical areas that we work, the engineers and maintenance professionals have a great deal of freedom to share ideas and resources without violating any anti-trust laws. We have done so through our professional organizations for many years. I am merely suggesting that we accelerate our relationships for the good of the industry at large.

I started out by describing the safety and quality successes which Union Pacific is experiencing. Those successes are based in large part on trust; a trust between management and the workforce. Similar relationships can be forged and strengthened between our various companies. Whether these relationships are between two railroads, railroads and suppliers, or between our various professional associations, there is much to be gained.

These relationships do not come easily and it is terribly easy to withdraw into the comfort of the old ways of doing business. But for those willing to step forward and take the

risk, the benefits are tremendous. I would very much like to be part of an industry that is recognized the world over as being progressive in all respects.

Railroad leadership has shown the desire to take those steps, but they don't have the power to make it happen. The power is in the hands of all railroad professionals. It starts with us. Each individual has something to share. We must all be part of the change rather than part of the status quo.

This conference is a good place for the revolution to begin within the engineering and maintenance-of-way segment of the industry. With representatives of Roadmasters, B&B, AREA, AAR, REMSA, and TRB present, we have most of the ingredients to open up dialogue in a way we have not seen before.

In conclusion, I would like to personally thank Ken Welch for his efforts in putting this presentation together. As it turns out, I'm a last minute pinch-hitter for Dick Davidson. As a result, Ken put together a draft of the basic thoughts he wanted me to cover in this speech. Those of you who know me very well know that I almost always write my own speeches and have a tendency to nit-pick anything anybody else does for me. Not so in this case. After reading Ken's draft, all I could do was add a few personal thoughts and say to myself, "right on." It's obvious that the Roadmasters Association is under extremely capable leadership.

I thank you for giving me your time this morning. If you have any questions of me, I would be happy to answer them. I will be here through Wednesday so you can corner me in the hall. Once again, thank you. Ken. (Applause)

President Welch: Thank you very much, Stan. Over the past several years, all of our railroads have downsized and in an effort to make professional organizations more effective, REMSA, Roadmasters, B&B, and AREA have agreed to work even closer than in the past. As a first step, Roadmasters asked AREA to come to our conference and give you, the first-line supervisors, an update of what AREA is doing to help you with your maintenance challenges. We, in turn, look forward to passing your maintenance challenges on to the AREA technical committees so that they can go to work on solutions that will help you.

I would now like to introduce Bill Stokely. Bill is the chief engineer of the Florida East Coast Railway Company. He is a graduate in civil engineering from the University of Missouri School of Mines and Metallurgy at Rolla, Missouri. He started his railroad career as a surveyor for the ICG. From 1965 through 1972, Bill served in various capacities in the bridge engineer's office. In 1972, he moved into the field engineer's office working in both track maintenance and construction areas. In 1976, he once again returned to the bridge department. In 1978, he was placed in charge of a major cost-reduction program at the ICG in the track maintenance area. In 1988, Bill moved to the Florida East Coast Railway and later that same year became chief engineer. Bill has served as chairman of the AREA Committees 7 and 1 and is currently on the board of directors of AREA. Bill.

RECENT CHANGES IN AREA RECOMMENDED PRACTICES IN ON-GOING COMMITTEE STUDIES

W. S. Stokely

**Chief Engineer
Florida East Coast Railway**

Good morning, ladies and gentlemen. It is as always a pleasure to be among friends, associates and acquaintances whose day-to-day purpose is to direct or otherwise provide for the maintenance-of-way, bridges, structures, and facilities of the railways. As Ken mentioned this morning, I am here as chairman of the AREA board of directors' Committee on Technical Activities. With me on that committee is Rich Johnson of Amtrak's northeast corridor project; Ray Snyder of the Chicago and North Western; Jim Palmer of SEPTA; Mark Hardy of CSX Transportation; Scott Lovelace from Norfolk Southern; and Carlos Davalos from the National Railways of Mexico.

Our purpose here is to give you a general idea of what the technical committees of AREA are involved in. As Ken mentioned, a few of us sometimes get bound up in the technical details of elaborate solutions and forget that what we are supposed to be doing is making it easier to maintain track. We certainly invite your input as to what we, the bureaucrats, the technocrats, should be working on to in fact make the Manual of Recommended Practices a more usable document.

My topic is the current organization of the technical committees of the American Railway Engineering Association. We present this along with a sampling of the current assignments of these committees so that you may better understand the role of the AREA within the family of technical associations whose members deal with design, construction, and maintenance of the fixed facilities infrastructure of the North American railroad system.

As most of you know, the purposes of the technical committees of the AREA is to publish and maintain the content of the chapters of the "Manual of Recommended Practices" and its attending Portfolio of "Trackwork Plans." As many of you are aware, these publications are revised on an annual basis to reflect the findings of on-going research and testing, the experience of committee members, and the action of regulators.

The roster of technical committees has changed. The board of directors has, since 1987, established three new committees to address areas of increased activity in the field of fixed guideway transportation systems using flanged steel wheel on smooth steel rail mode.

The impetus for the seating of these new committees has been the need to adapt and apply the considerable body of conventional railway technology to the fields of light density and short lines railway, rail transit, and high speed rail. Operations of these types in the past few years have become more important in the transportation modal mix of the North American continent.

Further changes came about in April, 1992, when a board of directors ad hoc committee commissioned a management consultant to undertake "A study of the Association's organization, committee structure and operation characteristics." The final report of the consultant was a primary topic of discussion at the November, 1992, annual meeting with the board of directors and the directors and the AREA committee chairman."

The board of directors continued discussion of the consultant's report tempered by the findings of its meeting of the committee chairman and finally in December of 1992 voted to adopt the divisional organization you see here.

The action of the board of direction neither installed the recommendations of the

consultant in whole nor did we accept all of the recommendations of the committee chairman. We did, however, organize committees of similar interest into a divisional configuration. Under the technical division of organization, we find the numbered committees assigned as follows:

Division 1, Member Services, consists of AREA Committee 24, Engineering Education. We note here that the consultant recommended a number of additional services be provided by the Association to its membership. While the board and the chairman, in general, did agree with most of these recommendations, it does appear neither the committee membership nor Association headquarters personnel can currently afford the man-hour resources necessary to implement the additional recommended services.

Division 2, Railway Engineering, consists of: Committee 1, Roadway and Ballast; Committee 2, Track Measuring Systems; Committee 3, Ties and Wood Preservation; Committee 4, Rail; Committee 5, Track; Committee 10, Concrete Ties.

The affiliation of these committees appears to be most logical.

Division 3, Structures, consists of: Committee 7, Timber Structures; Committee 8, Concrete Structures and Foundations; Committee 15, Steel Structures; Committee 28, Clearances.

Again, this group appears to be most logical.

Division 4, Buildings, Facilities and Equipment, consists of: Committee 6, Buildings and Support Facilities; Committee 14, Yards and Terminals; Committee 27, Maintenance-of-way Work Equipment; Committee 34, Scales.

The inclusion of Committee 27 in this grouping does, at first blush, seem awkward.

Division 5, Special Railway Applications, consists of: Committee 12, Rail Transit; Committee 17, High Speed Rail; Committee 18, Light Density and Short Line Railways; Committee 33, Electrical Energy Utilization.

This grouping also seems to be in order, at least with respect to its title.

Division 6, Engineering Support Systems, consists of: Committee 11, Engineering Records and Property Accounting; Committee 16, Economics of Plant, Equipment and Operations; Committee 32, Systems Engineering.

The committees of this group seem to have a considerable common ground.

You will note that three previously numbered committees do not appear under a division. These committees are Committee 9, Highway Rail Crossings; Committee 13, Environmental Engineering; and Committee 22, Economics of Railway Construction and Maintenance.

The work of these committees has been reassigned to other committees and the materials of the chapter of the Manual of Recommended Practices is to be redistributed to the various remaining chapters as it specifically may apply.

With that, we conclude our overview of the organization of the technical committees of our Association. We do add that the divisional organization functions only at the level of the committee chairman. It is our intent to use a part of the time at the annual meeting of the board of directors and the committee chairmen as a divisional meeting. At the divisional meeting, the chairmen will have an opportunity to discuss work of a common interest, to locate additional expertise, and to ensure that assignments of different names are not, in fact, a duplication of effort. The sign post of the path we wish to follow is marked as "work smarter, not harder."

Let's proceed now with the second part of the presentation in which we will briefly review the general responsibilities of the various committees.

Division 1, Member Services, is currently populated only by Committee 24, Engineering Education. It's responsibility is to maintain liaison with the academic community and promote additional needs of special railway engineering education. An example of an assignment for study in this committee is the student interest award program.

Division 2, Railway Engineering, consists of six committees. Committee 1, Roadway and Ballast, deals with that construction which supports the track system other than bridges and includes roadway fills, cuts and ditches, track ballast and sub-ballast, culverts, signs, fences, tunnels and waterways, pipeline crossings, vegetation control, and the application of geosynthetics to roadbed stabilization. This is a very large committee with a variety of tasks. An example of the study that is underway is a new assignment called foundations for highway/railway grade crossings.

Committee 2, Track Measuring Systems, concerns itself with the at-speed measurement of track geometry and the analysis of collected data. An example of a current assignment of this group is "How to Identify and Locate Priority Defects Detected by Geometry Cars."

Committee 3, Ties and Wood Preservation, deals with wood and materials other than concrete, used as cross and switch ties. A current assignment reads "Wood Tie Disposal Alternatives"; a timely matter for all of us.

Committee 4, Rails, is charged with all matters of track rail to include welding. A current topic of study is to "Produce a Standard for Tagging Heat-treated Rail."

Committee 5, Track, deals with all matters of special trackwork including track tools. An example of a current assignment is "Review Fastener Parameters for Rail-bound Frogs and Castings." This group is also responsible for the "Portfolio of Trackwork Plans."

Committee 10, Concrete Ties, has a narrow focus on the technology of concrete track, switch, and bridge ties and rail fastening systems. An example of a study topic for this committee is "Resistance of Concrete Ties to Freezing and Thawing."

Division 3, Structures, contains the three Bridge Committees and the very closely allied Clearance Committee.

Committee 7, Timber Structures, addresses the design of bridges and heavy structures of wood materials. Mundane as this topic may seem, the timber bridge is yet the most prevalent type of bridge construction in our industry. A current assignment in this committee is entitled "Methods to Upgrade Existing Timber Bridges."

Committee 8, Concrete Structures and Foundations, is another large committee with a wide range of work. Not only do they cover concrete bridges, they study concrete slab track designs, retaining walls of all materials, waterproofing, and all types of foundations for structures. One assignment reads "Formulate a Recommended Practice for Design and Construction of Concrete Slab Track with a Direct Fixation Guideway for the Rail."

Committee 15, Steel Structures, is the third and final of the "bridge" committees. Its focus is the design, construction, and maintenance of steel bridges. A current topic of study is "Painting and Abrasive Blasting."

Committee 28, Clearances, deals with the engineering aspects of moving high, wide, and heavy loads over the railway network. One of its current assignments reads "Clearance for Highway Structures over Railroads."

Division 4, Buildings, Facilities and Equipment, contains four committees. Committee 6, Buildings and Support Facilities, concerns itself with the design criteria for all matters of station, office, and shop facilities. A current assignment is entitled "Design Criteria for Centralized Maintenance-of-Way Equipment Repair Facilities."

Committee 14, Yards and Terminals, busies itself with all matters of yard and terminal facilities. The topic currently under study is "Security at Rail/Auto Terminals."

Committee 27, Maintenance-of-Way Work Equipment, concerns itself with the machines we use in the maintenance of our properties. A current topic reads "Training Programs for Machine Operators and Maintainers."

Committee 34, Scales, deals with track and other scales used in railroad operations. A current topic of study is "Track Scale Testing Guidelines, Test and Inspection Forms."

Committee 12, Rail Transit, is one of the newer committees and it deals with urban and suburban rail passenger systems. An example of a study topic is "Rail Corridor Evaluation."

Committee 17, High Speed Rail, looks at design and practice for wheel rail system for speeds in the 150 to 250 mile per hour range. One of its current assignments is "Track, Structure and Train/Track Interactions."

Committee 18, Light Density and Short Line Railways, directs its efforts to economical designs and practices for smaller, lighter used railroad operating properties. An example of an assignment is "Recommended Practice Concerning Use of Secondhand Track Materials."

Committee 33, Electrical Energy Utilization, concentrates on studies of use of electrical energies and the current assignment is "Safety Guidelines for Electrified Systems."

Division 6, Engineering Support Systems, contains three committees that deal with topics which are, for the most part, office functions.

Committee 11, Engineering Records and Property Accounting, is the first of this office-oriented group. It addresses such topics as accounting, drafting practice, taxes and planning, budgeting and control. A current topic under study is to "Report on Modern Planning, Control Techniques, and Methods of Achieving Cost-Effective Operations."

Committee 16, Economics of Plant, Equipment and Operations, applies engineering principles to the development of economic models for evaluation. This group is sometimes referred to as the "what if" boys. The current assignment there reads "Renewal with Concrete Ties, Complete or Part."

Committee 32, Systems Engineering, is responsible for the development of information regarding the application of computers and other technologies to enhance the productivity of the railway engineering professional. A current topic there is to "Develop a Recommended Protocol for CAD Drawings."

With that, we conclude the presentation. Our purpose here is to offer you information concerning the organization of the technical committees of AREA and to show the areas of responsibility within each of the committees.

Did you see a committee or an assignment that interested you or that would be of interest to your property? If so, come join us. We need you. (Applause)

President Welch: Thank you, Bill. At this time, I would like to turn the podium over to Don Steele who is the B&B Association program chairman for the next speaker. Don.

Mr. Steele: Thank you, Ken. At this time, I am pleased to introduce Dave Franz, bridge engineer from the Kansas City Southern.

Dave graduated from the University of Cincinnati in 1976 with a Bachelor's degree in civil engineering. That same year he went to work as a system bridge inspector for the Milwaukee Road in Chicago. In 1986, he left the Milwaukee Road and joined Envirodyne Engineers as a structural engineer and project manager. In 1989, Dave joined the Kansas City Southern as bridge engineer and is responsible for the inspection, design, maintenance, and construction of bridges, culverts, and structures. Dave is a registered professional engineer, a director of the American Railway Bridge and Building Association, and a member of AREA.

Dave and I are very good friends. To show the joint effort of railroads working together, I have worked with him on a number of matters and thoroughly enjoyed it. Dave.

BRIDGE SAFETY

David K. Franz

Kansas City Southern

Thank you, Don. Before I get started, I just want to say a word of thanks to the railroads and equipment suppliers who either directly or indirectly supplied me with the information we are going to see here this morning.

Now that the bridge worker safety rules have been in effect for about a year, I thought it would be quite informative and interesting to see how some of the railroads are dealing with these new regulations and look at what type of equipment is available and what is being developed. We are going to spend a few minutes looking at some of these things and some of the solutions a few of the roads have come up with. What we show you here is not an endorsement by the B&B of any particular method or system. We are just trying to show you some of the technologies that are out there.

The new rules apply to inspection, maintenance, and construction activities and they apply to any individual who is assigned duties on the bridge including inspection, testing, maintenance, repair, construction or reconstruction of track, bridge structural members, operating mechanisms, water traffic control systems, signal systems, communication and train control systems. I think what they are trying to tell us here is that it applies to anybody who is on a bridge.

The FRA has asked me to remind all the member roads that this is indeed the case. They are a little concerned that some people have not been brought up to date on the bridge policies, at least the ones outside of the bridge department, and they want to make sure that all the railroads realize that this does apply to everyone.

What is a bridge? For the purpose of these rules, they define a bridge as any structure 12 feet or longer supporting a track structure above either the land or water. A personal fall arrest system or safety nets are required whenever a person is working more than 12 feet above the ground or water. Now, if you have a minor repair or inspection where it's determined that the installation of a fall arrest system poses a greater risk to the individual, they do allow you to go without. However, you can't take that decision lightly. The onus is on you to show that it is indeed just as much of a risk to install a system as it is to go without.

Fall protection systems do not apply if you are doing minor repairs between the outside rails on a bridge such as track welding, spiking, anchoring, spot surfacing, et cetera. But, there again, you need to be careful. You must really do everything you can between the rails.

As we said, the rules say that if a bridge is more than 12 feet high you need fall protection. Therefore, if you have a bridge less than 12 feet, you can still go about your business without providing fall protection. There are a few of those out there, but I'm afraid most of them fall in the above 12-foot category where you are going to have to get out there with your full fall protection system.

One of the most important things in fall protection is training. You can buy all the equipment and fancy systems in the world, but if your people don't know how to use it, it really isn't going to do them any good. Training is very important in getting qualified personnel who are familiar with the equipment and who can explain how to use it properly. Many of the railroads have developed specific training manuals that highlight the rules and explain them in a little easier language than the Federal Register and they often provide videos or questions and little tests just to make sure all their people are familiar with the rules. I know a lot of the railroads also require all their contractors and anyone else to go through a training program prior to working on their bridges.

Let's look a little at the personal equipment. Any anchorage system or system that has to hold an individual has to be capable of holding 5,000 pounds per employee. This applies to the harness itself and the lanyards and the anchorage. Prior to the use of any equipment, you should always inspect it and make sure it is still in good condition. Certainly if any equipment has been subject to any impact or fall, it should be removed from service until it can be inspected by someone who is qualified to say that it's still good.

Full-body harnesses are what is being used. Safety belts that were used in the past won't cut it anymore. Full-body harnesses divide the load around the body really well and provide the greatest protection to the employee. They also have the metal D-rings in the middle of the back and that would be the primary tie-off point. That's the best location to take the load if you do have a fall situation.

Employees with full-body harnesses holding up the lanyards also have their hardhats and safety glasses on. The bridge safety regulations do address personal safety equipment or protective equipment. That's really no change from what the railroads have had in place in the past though.

The metal ring on the top is the D-ring that goes in the middle of the back. The two rings down near the bottom are positioning rings and they would be near the front of the harness at the waist. They allow us to tie off to a working position and it can come in real handy in certain situations to leave both hands free for other applications.

On a shock-absorbing lanyard, there is webbing that is folded over and stitched together. The requirements are that you are allowed a maximum of six feet of free fall and three and a half feet of deceleration. That stitched portion of the lanyard provides deceleration. As you reach impact, those stitches will slowly pull out and slowly decelerate so there is not a shock to the body.

There are several different types of deceleration lanyards available, but they are all of the same principle. This is a lanyard that has a retrieval ring on it, and we are going to get back to this later when we get into rescue and retrieval, but this is kind of a slick idea that one of the roads came up with. Attached to this D-ring is a double-locking snap hook. The old lanyards only had what they called a single lock. It wasn't really a lock and there was a concern that if there was a problem, if a part of the lanyard or something else got over the hook, it could actually open up during a fall situation. This D-ring requires that you press the little corrugated thumb lever on the right side before you can actually open the hook and prevent what we call a roll-out situation. This is required by the regulations.

A retractable lanyard is kind of a centrifugal clutch. It allows the cable to move slowly in and out of the reel. It is really good for vertical work and has some application for horizontal work also. The advantage of this is you don't have a lot of lanyard laying around. It's not a tripping hazard or anything. I guess if you are in a situation, though, where there is a possibility you may have to make a quick move or exit, you may want to think twice about this because if you try to jump away in a hurry, you are not going to go any place at all.

A rope grab is really good for vertical applications. The rope moves up and down. There again, if you go into a fall situation, it's just a mechanical bind. It just pinches the rope and stops you from falling. The hook that lays on top of the belt is one of the old single-locking snap hooks. It does not have that thumb piece on the backside of the hook that actually prevents it from opening up. There is a spring sticking up on the inside of that hook where a double-locking snap hook and the spring is popped out. This all gets back to inspecting your equipment before you get out there as this would be taken out of service. This certainly isn't an acceptable condition.

Just where that lanyard starts to get fat, you can see some white stitching marks. If you could see the broken stitches where the lanyard ties into the shock absorber, there has been some damage. It has probably been subjected to an impact load and that should also be removed from service. It's important to inspect this equipment before you use it.

A wire rope lanyard has a lot of kinks and twists in it and probably is not capable of holding the forces it was originally designed for and should be removed from service.

Now we have talked about the portions of the system that actually attach to the body; the harnesses and the lanyards. Those are pretty straightforward. There are a lot of different kinds available and are all pretty good products. That's the easy part of the job. The hard part is finding a place to tie off sometimes.

Certainly when you are working on a truss or some type of span, there are a lot of places you can usually tie off, but when you start getting in a span placement where you have large voids or spaces where there is no structure to which to tie off, then you start running into some problems.

I think horizontal static lines are used predominantly on the railroads for a lot of their tie off applications. When starting to hook up the anchorage for a static line, the metal canister is a shock absorber that is built into the static line. Tension static lines are being readied for use. A static line is already mounted on the deck where some bridge repairs are going. It is in use and they are tied off to that. They have very small retractable lanyards fastened just below their back. There again, that keeps a lot of cable or lanyard from laying around on the deck, which can create a tripping hazard.

A static line that is mounted at deck level is for a span changeout. They have already removed one set of the stringers and it looks like they are getting ready to take the other set out. Here again, there is the static line up at deck level and this works really well. A retractable lanyard is hanging from that as guys move down to work below. They can just hook onto that line and everything is pretty well out of the way for them in that case.

With regard to steel repairs, they have two static lines. One is just outside of each rail coming in with the floor beam. Here again, one thing you need to be aware of when you have a static line down at deck level like this and you are moving large, heavy pieces of steel or whatever, is you have to make sure that a static line is out of the way of the steel or whatever you are moving and that it doesn't get caught. If it was jerked by a crane, you could actually yank somebody who is tied off to the lanyard. If there's a situation where you are going to be bound up with the lanyard for a little bit, you may have to have the people take their tie off the lanyard and get it out of the way until you can clear your lanyards. It's one of those tough situations you have to work around.

There is also the anchorage method that one railroad has come up with for anchoring a deck level static line. It's a steel beam clamped onto the flanges of the rail. Here again, the shock absorber is attached to your static line. They have put two static lines, one on either side of the main, and they are tied off to it and doing their work. They have the retractable lanyards that keep tension on the line so you don't have cable lying down on the deck.

As the guys are pulling their ties out, these guys are having to yank the static line out of the way so it doesn't bind up with the ties. It would be even more of a problem if they didn't have that other main. It would be a tough position to be in. If you are trying to take out track and panels, which we are doing pretty heavily on the railroads now, this gets to be an awkward situation sometimes. You have to plan your system around some of that.

There is a bracket that is going to be used to mount a static line off to the side of the bridge and elevate it a little. This particular mount is actually clamped onto the girder flanges. It's obviously not going to be good for passing a lot of train traffic, but I think for a lot of these cases you can at least sneak a train by it. Also once you get your cable strung up, it even provides a bit of balance or handrail out there, although that's not its intended function. It is mainly a tie off line.

In regards to the elevated static line during a change-out, the deck is being lifted out and the cables from the crane are hitting quite heavily against the static line. Here again you have a situation where it is hard working around these and if there's the possibility that you are going to be jerking out and giving pretty good jerks on the static line, you may want to get

your guys back off the bridge and get off the tie off for a few minutes.

Once you have the span out of the way, this is a real good location. It's really easy to reach to tie off and you don't have too much lanyard hanging around there. The static line is still strung across there as they are getting ready to set their spans. That should work just fine. In this way, they can come in from the sides and stay underneath the static line.

There is a similar type of static line that is mounted on a trestle that would be really good if you were going to do a detailed inspection or some minor work, or where you have to get on the outside of the rails.

This is a relatively new product. I don't have any pictures of it on a bridge, but it mounts to the base of the rail. The static line is actually outside the railroad standard clearance diagram. This has some real uses and applications if you are doing a major bridge change out. You could keep adding intermediate supports and string this all the way across the bridge. When you get to a particular span to change out, you could remove one of those supports. Just make sure they are spaced properly for the number of people you have to have tied off. That's all recommended by the manufacturer.

During steel repairs, the men were getting access to the top floor by climbing up and down the diagonal. They just went ahead and took a rope and tied it on top and the bottom and they have a rope grab there. As they move up and down, they tie off on this rope grab.

Here again is a major span renewal. For pulling out entire deck sections, we couldn't think of a really good way to keep the static line out of way. What we had to do when we got ready to pull the deck section was to take our static line off and pull the section. We then put a static line back up there while we tied off on our stringer chords and got them ready to pull out.

We were able to get those all out of the way without any interference from the static line. We were a little concerned as these large bents were coming out. We were afraid of binding up on the static line. So once again, we pulled it and as soon as we set spans, we re-established our static line for the remainder of the work. It worked pretty well. There are a lot of problems that go into it and you have to think through all of them pretty carefully. Each job is different.

Another new system that several railroads have been working with a supplier on is a static line that's over the center line of the track. It's mounted about six or seven feet about track level. They have modified this a little bit. The anchorage point is a good distance away from the tripod and several railroads expressed concern that they needed to be able to move their work equipment right up to the tripod or the end of the static line. Therefore they modified this assembly so you can do that.

This is a pretty stout system that you can tie five or six people off, as I recall, and keep adding intermediates if you need to. I don't know if this is something you would set up for a real small project. Obviously you can't run trains with it here. However, if you have a major span change-out and want a static line, it is in the center. So if you can work to either side of the center, this might be a pretty good application.

The anchorages for that same system fit over the rail and you tighten bolts down on the web of the rail. Your lanyards are out of the way and you can still reach the sides of the bridge. You can also use retractable lanyards if you need to get a little more distance on it.

Another system that we have been developing with the suppliers is really more for minor types of things. It's only a two-man tie off. The top line is actually a static line. The other two lines are optional. They can be put in. It essentially can act as a portable handrail. It sets up pretty quickly and clamps to the ends of ties or a guardrail. They also have a system that will fit over the ball of the rail and you can actually set it up right on the rail. It sets up in a big hurry.

There, again, you can tie two guys off to it. On some smaller spans we have to move fairly quickly down the track. It's something we can set up pretty quickly and take down

pretty quickly yet would allow us to remove track panels and things underneath.

In addition to static lines, there are also many applications where you can just tie off on one fixed location. An individual with his safety harness tied off on a truss doing some repairs up above has what some people call a tie-off adaptor. A little red wire cable is wrapped around a rail in this case and then the lanyards are tied off to it. It's a real handy little deal. You can use them just about any place if you are not going to be moving too far from a fixed location. These have been used for spot repairs. It is certainly a quick system to tie into. You just don't want any trains to go by.

Referring back to the little ones that wrap around the rails, they have the retractable lanyards. A little bit of a problem that you're dealing with is he has a tie-off point again and he is working with his wrench. He has his air hose and his retractable lanyards kind of tugging on him and wrapping around him. If you add to that maybe being down in South Louisiana in the summertime where it is 100 degrees, it's not a lot of fun.

One of the toughest things with these guys is convincing them that this is the way it has to be and that it is really for their own benefit. Anything that you can do to make the system accommodate your employees better and be less of a problem for them to use, the more success you are going to have getting them to use it.

Tying off around the pile or brace for cutting off a piling is a similar type of application. There is a web or nylon type of tie-off adaptor. It has two D-rings. One is a little smaller than the other. You just wrap it around something and slip the small D-ring through the large one and then use your lanyards on it.

This is what we call a rail puppy. It clamps onto the rail and will move along the rail with you. There are a few manufacturers out there with these. The one problem with these at this point is I don't think there are any available that actually will get by a field weld. They will usually get by your flash butt weld, but they seem to have a problem getting by the field weld. So there is limitation, but they are pretty handy.

The one concern I have heard a few people express about these is that if you are using them for inspection purposes and are climbing down below and decide to unhook from that and hook up on another location, this could be a major problem if a train came along. I think we use them quite a bit where we've actually got track time, but you need to be really careful. If you are out there without track time just working in traffic and using something like that, you need to think really hard about how you are using it and make sure you are aware of what you are doing. It's easy to get busy and not be thinking in those terms.

I don't have anything on safety nets in terms of slides. I just wanted to briefly mention that they do have requirements for safety nets in the regulations and they should be as close to the working surface as possible, but they can't be more than 30 feet below the working surface and the fall must be unobstructed.

You can't have a bunch of laterals or braces down there before a guy hits the net. If you are going to use a safety net, you are supposed to perform a drop test with a 400-pound bag of sand, 30 inches in diameter dropped from the working height. Safety nets including the installation and testing are discussed pretty much in detail in the regulations.

Our personal philosophy at our company is that if we need them, we will get some professionals to install them. We just don't want to get into that business. But that's certainly another option that you may be interested in using.

A block and tackle system is one of the other systems that are available to help you do your work. This gives you an adjustable height system. A worker has a Bosun's chair attached to it and can actually pull himself up or let himself down and adjust his working height. In a similar application but without a Bosun's chair, he would be in a harness.

This gentleman has a rope that is fastened up top while he is on a ladder and there is a rope grab on there. If he should fall or the ladder became unstable and fell, the rope grab would cinch up and hold him. The top picture also has rope grabs on the ladder for safety.

Regulations require that if you are working over or adjacent to water that is over four feet deep or where a danger of drowning exists, such as high velocity water, employees must wear life vests unless they are using fall protection. Life vests are not required if you are performing inspections that require climbing on the structures. This is because the bulk of the vest could be more of a hazard than a help in some cases.

Vests, again, should be inspected prior to each use. When you are using life vests, you are required to have rig buoys present with a minimum of 90 feet of line attached. The distance between the rig buoys cannot exceed 200 feet. Therefore, you are all right unless you fall in that middle 20 feet.

When you are using vests, a lifesaving skiff or inflatable boat must be available for immediate use. If conditions warrant, you need it to be manned. In other words, if you have fast currents where someone could be quickly swept away, you had better have a manned boat ready to make sure you can rescue the person immediately.

Scaffolding is also covered in the regulations. They are pretty detailed and they are geared towards some pretty stout scaffolding. For a lot of applications where you would be hanging scaffolding just for bent cap change-outs or things of that nature, you could probably go ahead and use your personal fall protection along with it.

Some other things that people have come up with include a static line that has been mounted to the side of the crane so that employees have to move back and forth along the side of the crane to have a place to tie off. You can also do this on your bridge trucks and boom trucks. One thing we have been doing, and I think it works pretty well, is where regular lanyards are tied off. Leave it really short like 6 or 12 inches, and just leave it hooked to the cable.

If someone has to move along, they just hook that off to their positioning ring if they have one on their belt and they can move along the truck. That way it is always there. We also do something similar on the ballast cars when we are dumping ballast on bridges. You can either have a fixed point or some type of tie-off point so your people are tied off properly.

This is an interesting idea regarding hand railings on an inspection walkway on a movable bridge pier. It involves putting a walkway on a boom car for their crane. It is something you don't always think of, but if you have a crane out on a bridge, it is certainly susceptible to a fall and maybe more so, being on moving equipment. This may be something else to consider here. Providing handrails for walk out and pier protection would probably be a real good idea in the northern climates especially in the winter where you have a lot of ice and snow to contend with.

This shows temporary bridge handrails on a ballast deck bridge. I don't know that there is a whole lot of bridge work you could do within these handrails, but certainly if you have a system track rail gang moving through, it is a pretty good way. This way they don't all have to contend with tying off.

If you have a handrail system that does meet the requirements for a conventional walking handrail and that's acceptable, then you could get by without having to tie everyone off. That's just another alternative you can look at.

A temporary walkway with handrails uses the same philosophy as the last one basically. It allows me to perform the work. The bottom of the same system is just bracketed off the handrails of the guardrails and ballast timber. I don't know how much this really applies, but in some applications maybe the best way to go at it is to get a snooper truck to get access to locations. I'm not sure. The requirements and regulations aren't real clear about whether you would require a tie off. I would certainly use a separate tie off from the boom. I have been around those things enough to know I don't like them.

I guess the last area I would like to touch on is rescue and retrieval. If you are unfortunate enough to have a fall, you have to have a way to get that individual out and get him medical attention, if required.

This is setting up and mounting on the rail of a portable kind of a winching frame. It is set up and hooked onto the employee and they are winching him up to the deck level.

This is the lanyard with the rescue ring that I showed you earlier. A guy from the Union Pacific came up with this and it is really a slick idea. The lanyard is hooked off to the right with a double-locking snap hook to an anchorage point. Now if the person falls off, you obviously have a lot of tension in that lanyard at your tie-off point. Those snap hooks aren't that big. It would be pretty hard to get hold of that lanyard to try and bring the employee back up. They take the hook from the boom truck and they can grab hold of this ring just off the anchorage point of the lanyard. He then takes the tension off the anchorage point with his boom and he can now unsnap his hook. Now he can lift the employee to safety. That was a real good idea, whoever came up with it.

I guess that about does it. There are some portions of the new regulations that I think present problems for the railroad industry, but certainly the intent is to provide a safer work environment for our fellow employees. I don't think anyone can argue with that. As long as the implementation and enforcement of the safety standards focus on actual worker safety, I think this should be a real good thing for our industry. Thank you. (Applause).

President Welch: Thank you, Dave.

With the floods of 1993 still on everybody's minds, we have asked Steve Hill to give us a preview of what the CP Heavy Haul encountered on the Grand River. Steve is assistant division manager-engineering for CP Heavy Haul in Chicago. He began his railroad career working as a section laborer in the summers while he was in college. He graduated from the University of Kansas in 1972 and then went to work for the Union Pacific Railroad on a section crew.

Steve completed his civil engineering degree and joined the Illinois Central in 1977. In 1980, Steve joined Soo Line in Minneapolis as office engineer. He completed his MBA at the College of St. Thomas in 1987. Later that year, Steve moved to Chicago as assistant regional engineer. He is immediate past president of the Roadmasters Association. Steve.

GRAND RIVER FLOOD OF 1993

Stephen Hill

**Assistant Division Manager – Engineering
CP Rail System**

Thank you, Ken. Good morning, everyone. The big news story this summer obviously was the flooding in the Midwest.

While the Missouri and Mississippi rivers got most of the media attention, there is a smaller river in Missouri that caused quite a bit of trouble for the five railroads that cross it. This kind of became the choke point between Chicago and Kansas City: the Grand River and its tributaries, the Thompson and the Weldon. Five railroads have to cross it. The North Western, the CP, the Burlington Northern, the Santa Fe, and the Norfolk Southern. All of them suffered outages and damages. Some more than others.

I just want to note that this afternoon at the AREA technical conference there will be some presentations that will go into quite a bit more detail on the Santa Fe and the Union Pacific and cover quite a bit broader spectrum on all of their problems. We are going to talk about just one little river here.

All five of these railroads have to get across this gauntlet in Missouri, and for most of the month of July and into August, the Grand River made this pretty difficult on everyone. The people who work around the Grand River and live there have kind of grown used to its shenanigans. It tends to go up and down really fast, kind of like an elevator. However, this time it outdid itself.

On June 30, the North Western was the first one to start experiencing trouble in this drainage area. They were knocked out of service over a 40-mile stretch of track several times during the next two weeks. Debris is a big problem on this river. A lot of trees come down this river and stick in the bridges. We get a lot of scouring and a bit of undercutting there. There's good pile penetration or there used to be.

Next up was the Norfolk Southern down at Brunswick, Missouri, where the Grand tries to make entry into the Missouri. On July 7, they had their washouts and after a while, with the Missouri coming up, it became really an academic question of was the Grand causing the problem or was it the Missouri. Norfolk Southern ended up with about 2,400 feet of washouts in several spots up to about a 12-foot depth.

The next day it was the CP's turn. The Grand River at Chillicothe is normally about 200 feet wide. When it crested through Dawn Bottoms there on July 9, we had four and a half miles of rail under water. The normal level for the Grand River measured at Chillicothe is about 10 or 12 feet. On July 9, it crested at a record 38 1/2 feet which is four feet higher than the previous record in 1991. Flood stage is considered to be at 22 feet.

Santa Fe had the big problems, obviously. The Burlington Northern had some problems at Sumner, but compared to the other problems they had, like a dike across the main line at Ottumwa and everything else, the Grand River didn't really cause the Burlington Northern a great deal of problems. They did have some washing there at Sumner.

On July 10, however, the Santa Fe had major problems. This was a 98-foot long double track bridge five and a half miles east of the Grand River.

This is not even the Grand River crossing. This is a small drainage ditch through the farm fields. Normally the track sits on about a 10 to 15-foot high fill across very flat land. As you can see there, the three ballast cars that were on one of those tracks are down in the hole. That caused quite a few problems for the Santa Fe in rebuilding those bridges later. As the water went down, you began to get a better picture of what kind of damage you ended up with. There were a lot of spots like the CP at Chillicothe. We had about 6,000 feet of washouts in 23 different spots spread over five miles.

When something like this occurs, you begin to wonder where to start. You have a bridge pier on your mind. The CP in Chillicothe experienced a drop in a bridge pier. When it finally settled out, it dropped about five feet and shifted and we had to get a marine contractor in there to start setting up to drive pilings to raise that bridge. There was a lot of debris that had to be removed. Sometimes you wonder where it came from. They tell me this is supposed to be a roadmaster's office, but I'm not sure.

Where the Santa Fe got blown out, they had to widen their fill about 20 feet to put the first track back in on an offset alignment because of all the bridge pilings and debris underneath. There's about a 40-foot deep hole there that was scoured out. Then you begin bringing in all the pile drivers and getting it all set up. Santa Fe had three pile drivers working.

That's where the wall of water came through. The first bridge they built was 273 feet long to replace the 98 footer.

The Grand River wasn't finished with us though. On July 23, the water started to come up again. Back at the CP track, they were trying to get the first piling in there to try and

stabilize that sunken pier. However, the water was coming back up again. On July 24, the Santa Fe got their track open. On July 25, the river crested again at 38.3, which is just two-tenths of a foot below the record crest of 16 days earlier.

This is the point where the people really got frustrated because they just finished fixing 6,000 feet of wash-outs. This is when the track inspector down there just groans and says, "But we just got done!"

We had to move the pile driver out and set it on a little pad of rock and get it up so it didn't get flooded out. Santa Fe continued with their second bridge here. Because of all the debris and couple of ballast cars out there, the second track had to go in as a thru-girder.

The water finally did go back down. This is getting close to the normal level and you can see that CP was fortunate that the old pier that had sunk did stabilize enough. They were able to use that to do most of their jacking and raising the pier after they got all the piling in.

But the water wasn't completely done. It had to give us one more little tease here. CP finished their track and had it back in service on August 2, finished the bridge and the track was back in service on August 3. On August 7, the Norfolk Southern finished their work repairing the damage caused by the Grand River at Brunswick, but it was not until August 21 that all the damage on their line to Kansas City was repaired and trains started running there.

At this point you have to look back and take into account the incredible job that everybody did on all the railroads.

It is interesting to note that in times like this you rarely have injuries. Rarely. There is a heightened awareness out there and even though they are working in terrible conditions, hot, torrential rains, and mud, everybody has that little bit of extra awareness and they don't seem to have that many incidents happen. What we need to look into is how do you keep that level of awareness on a regular day-to-day job where complacency causes problems.

However, in talking to the Corps of Engineers, I did find out one thing. According to the U.S. Geological Survey who just completed a study of the flooding on the Missouri River Basin here this summer, they are saying that this flood on the Grand River based on the out-flows or the amount of water coming down river only equals a 75 to 100-year flood. All the high water levels or record water levels came from a lot of the dikes and levees that farmers had built over the years. When these dikes let go, that's obviously what tore out the Santa Fe.

There is a big concern with many railroads on the levee systems around here and the aggravation and the extra problems it causes when you do have large flows. You put a larger flow in a smaller area and it goes higher.

Bearing this all in mind, we at the CP did make a couple of changes in our standards for our proper railroad flood attire. The railroad watches now have to be approved for a 30-foot depth and the waders are obviously steel-toed. (Laughter)

That's a little bit about the choke point and the problems that the Grand River caused between Chicago and Kansas City. That's all I have. If there are any questions that anybody has, I would be glad to answer them. If not, thank you very much. (Applause)

President Welch: Thank you, Steve. I think you hit it on the mark when you said looking back it's clear that the people involved have performed miraculously all over the Midwest this year. At this point, I'll turn the program over to Darrell.

Mr. Cantrell: Our next presentation will be Michael Ongerth of the Southern Pacific Railroad. He is going to talk to us about high speed transportation which will affect all of us in this room in some way in the future as we get more and more high speed transportation.

Mike received his BA degree from San Francisco State University in 1966 in public administration. He received his MBA from the University of California at Berkeley in 1968. Later in 1968, he joined the Southern Pacific Railroad and has been with them ever since. He has held various positions in the operating department for the Southern Pacific. From 1980 to 1983, he was superintendent of the western division and vice-president and general manager of the NWP Railroad in Oakland, California.

From 1983 to 1984, he was general manager passenger operations in San Francisco. From August, 1984, to August, 1988, he was assistant vice-president intermodal operations at San Francisco. From August of 1988 to January 1, 1990, he was assistant vice-president operations at San Francisco. From January 1, 1990, to July 1992, he was assistant vice-president administration services at San Francisco. In August, 1992, to the present, Mike holds the position of vice-president strategic development at San Francisco.

Mike comes to us with a very good presentation on high speed. For all of us in most Class I railroads and even short lines, it's getting to be more and more high speed with Amtrak trying to take on new routes. Mike.

HIGH-SPEED TRANSPORTATION

Michael Ongerth

**Vice-President Strategic Development
Southern Pacific**

Thank you, Darrell. I hope I can live up to that billing.

What do we mean by high speed rail? I think it's really important that everybody understands that there are several different concepts that are being discussed. I think we will start by defining what high speed rail may mean for your system.

First, high speed rail, as I will talk of it most of today, is what I'm going to call conventional high speed rail. We are talking about top speeds of 79 to perhaps 110 miles an hour and averaging speeds somewhere in the 50 to 75 mile an hour range. Then we have what is beginning to be called within the industry, at least among the consultants, as very high speed rail. This is top speeds of 125 to 150 miles an hour.

Technology is different from the kind of passenger trains you see in the United States today although we have had demonstrations of at least two types of equipment that can reach these speeds. I'm sure many of you perhaps even had a chance to see and maybe ride the X2000 as it went around the United States. It was certainly all over the West Coast and Midwest as well as on the Northeast Corridor, and then more recently the German ICE train. One of those trains has a tilting capability; that's the X2000. The ICE train does not.

Then finally we have a third category of what we are calling ultra high speed. The French TGV system and the Japanese Shinkansen and MAGLEV right now are lumped into this category. These are speeds in excess of 150 miles an hour.

One thing to note with that type of a system, it appears that neither present railroad rights-of-way nor freeway rights-of-way will be adequate to implement high speed rail in those rights-of-way largely because ultra high speed rails take vertical and horizontal curvature, which you just don't find on the conventional rail systems or on the freeway systems in the United States today.

My remarks are going to focus largely on the first category although I will talk a little bit about future potential for very high speed. That's because, at least in the Southern Pacific service territory, each of the agencies that are looking at some type of high speed passenger transportation basically are really talking only about high speed using conventional equipment with incremental improvements over time that would get them ultimately perhaps to the

very high speed rail category.

There is a lot being written about the ultra high speed passenger service potential in this country. I'm going to give you some examples and I will give you orders of magnitude numbers at least as they apply to California to get an idea of what we are talking about.

We have a corridor in California that Southern Pacific is promoting between Los Angeles and the San Francisco Bay Area that's about 400 miles long. The existing line has passenger service on it and some freight service although we have an alternative route for most of the freight service. It's scenic and it ties the two major population centers together. You can upgrade that line, upgrade the signal system, upgrade the track to FRA Class 6 standards, do some easing of curves and get the elapsed travel time between L.A. and the San Francisco Bay Area down to the five-hour range.

At present, Amtrak service on that route takes 11 1/2 hours to go between the San Francisco Bay Area and the Los Angeles area. You can do that perhaps for somewhat under \$390 million.

To put very high speed rail on that same corridor, and that would be a good application for that corridor because of the curvature and to electrify it, you could probably do that including getting the passenger equipment that would be necessary for somewhere in the \$2.5 to \$3 billion range.

To do ultra high speed rail on that corridor, you are talking about basically having to go out and create a green field alignment, to permit it in an area where you have to work both with the California Coastal Commission and with the Corps of Engineers and regional planning agencies filing environmental impact statements. Then if you could get it permitted, I repeat, if you could get it permitted, you would probably be talking about the \$15 to \$17 billion range.

It is because of these orders of magnitude funding requirements that we believe most of what all of us will see during our work careers is going to be high speed rail and maybe for some of the younger ones in the room, very high speed rail.

There is a lot of interest out there. There is a lot being written about this. There is a lot you will read in the trade press. There is a lot you will read in the newspapers. Some of it is grounded in reality. Some of it is pretty dreamy. Sometimes it is kind of difficult to determine what is reality and what is dreaming.

Let me tell you a little bit about what is going on within the Southern Pacific system. There are actually six potential high speed corridors that Southern Pacific could participate in as we see it today. One would be in the state of Oregon under the auspices of the Oregon Department of Transportation. It would extend what is actually a high speed corridor being worked on in the State of Washington with the Burlington Northern Railroad in the Vancouver/Seattle/Portland corridor and would extend that corridor through Oregon down Willamette Valley as far as Eugene.

I spent all day Friday meeting with the Oregon Department of Transportation people talking about what their plans are. Their plans fit exactly into the model that I just described in terms of incremental improvements to basically first get speeds on the line up to 79 miles an hour and then push the speed up to the 90 to 110 mile an hour range over the next 10 to 15 years.

In California, we actually have two corridors that are being looked at and these corridors could ultimately form a fairly extensive network of high speed rail service within the State. There is the San Joaquin Corridor and there is this Coast Corridor which I have already described that connects San Diego and Los Angeles in the south with the San Francisco Bay Area and the state capital in Sacramento in the north, and provides the potential to add service and mobility both in the San Joaquin Valley Corridor on the coast route, Monterey Bay, San Luis Obispo, Santa Barbara, and Ventura County area on the coast.

In California, the principle lead agency is the Department of Transportation Division of

Rail and I know there is some Division of Rail people here in the room today. I'm going to come back to that corridor or that network of corridors. It actually serves as a very good laboratory to describe the kinds of things that we are looking at and the kind of impact that it has on maintenance of way and engineering officers.

The State of Arizona is beginning to look at the potential for high speed rail principally between the Phoenix and Tucson area. They are also looking at the possibility of extending service from Phoenix up to the Grand Canyon and from Tucson east to Benson and Douglas and down to Nogales. There is no funding identified yet. That is only in the study stage.

The state legislature has a joint committee that has been looking at this for the better part of a year. I have started to attend meetings that they have about once every other month. That's a corridor where I think something will happen although I don't think it will be something we will see happening within the next year or so.

Colorado and New Mexico are beginning to look at the possibility of a corridor between Denver, Albuquerque and El Paso. That one I haven't been involved in and I really don't know how far along that is. I know they have a consultant on board and I know they are beginning to look at it. I can't give you a good indication of how real I think that corridor is.

Then we've got Illinois DOT and that impacts the Southern Pacific on our route from Chicago to St. Louis.

Within the Southern Pacific territory, we will probably see a movement to begin to fund improvement for higher speeds in Oregon, Illinois and California and it's really going to be kind of a horse race to see who is going first.

Then finally we have a corridor in Texas which is actually being looked at right now as a ultra high speed corridor. It is something called the Texas triangle. It has been talked about putting passenger service in the Texas triangle for at least ten years. There is a privately-funded consortium that's out there looking at this and attempting to get environmental clearance to put that first line through from Houston to Dallas. Southern Pacific potentially could be participating in that.

There are some sections of our rights-of-way that could be used, particularly in the Houston area. The potential for our involvement in a major way would come if they were unable to permit this as a ultra high speed route on a new alignment and they wanted to come back and look at using existing railroad rights-of-way and go the conventional high speed approach with incremental improvements on existing rights-of-way.

There, Southern Pacific participates both between Houston and San Antonio and Houston and Dallas. Probably a combination of Santa Fe or Union Pacific or perhaps only Union Pacific would be the other leg of the triangle.

I might say there is an interesting way that one can participate and not have passenger trains on your railroad at all. As you begin to look at the market, you look at the elapsed times that you want to achieve. You look at the barriers to developing those systems in a cost-effective manner; something that people can afford to purchase and fund on the one hand and look at the requirements of the freight railroads and their needs to continue to provide at least the level of service they are providing today and perhaps an improved level of service in the future, particularly if we can recapture business that is on the highway.

We then get into some real challenging decision making. One technique I think a lot of us will begin to adopt is to try to find a way to remove as much of the thru-freight operation from the corridor as we can onto an alternative corridor to free that corridor up for passenger service.

It so happens that between the Houston area and the Dallas/Fort Worth area both the Southern Pacific and the Burlington Northern have lines that presently are not operating at capacity for freight. It may very well be that the appropriate route for a high speed passenger service between Houston and Dallas would be on the Burlington Northern corridor.

So how would Southern Pacific participate? By getting into a joint facility sharing

agreement with Burlington Northern that would move the Burlington Northern trains over onto the Southern Pacific.

That now brings me to California. I want to describe in more detail the types of things we are looking at in California and I'm going to use two corridors to do so. I will talk first about the coast line and secondly about what we call the capital corridor. I'm going to define the coast line corridor as being between San Francisco and San Jose in Los Angeles and the capital corridor presently runs between San Jose and the East Bay and Oakland and Sacramento. These two link together and form a network. A portion of the capital corridor also presently serves as the origin for the San Joaquin Valley services.

On the coast corridor, we presently have a local freight operation. We have thru-freight operations; that is, two freights a day in each direction, and we have the ability in California on Southern Pacific to route the thru-freights over onto our San Joaquin Valley route. I might say that we competed very vigorously with Santa Fe to attract the San Joaquin Valley passenger trains to our route. We were not successful. The Santa Fe was able to retain those trains. This means that we have no real barriers to move any additional freights onto our routes through the San Joaquin Valley.

It's quite easy for us to shift the thru-freight service that is on the coast line over to the San Joaquin Valley route. We can still provide the level of service that is necessary to keep the customer base that we have today and so that's what we will do. That leaves the coast line as a corridor which can be developed for just about whatever level of high speed passenger service the market will support.

The capital corridor is an interesting corridor. It's between Oakland and Sacramento. It's an existing double track railroad, ABS signal system. There is some welded rail, but almost 80 miles of jointed rail. A lot of it is in the 113 and 112 pound and below range. It has over a billion ton miles on it right now so the rail certainly needs to be replaced. It's signaled for operation in one direction only so current traffic operation is relatively inflexible and yet it has tremendous potential.

If one goes out there and replaces the jointed rail with CWR, puts in a modern traffic control system with appropriately spaced control points and cross-overs, you can put an awful lot of traffic on that corridor and not really build any new railroads.

In the long-term, that corridor has a wide right-of-way that goes through an area which is seeing increasing urban growth and actually has the potential to be the high speed corridor and a commuter rail feeder to the Bay Area Rapid Transit System or the BART system. We could ultimately see two high speed tracks on that right-of-way, electrified, and in addition, a single track freight line with passing sidings. That would basically handle almost any level of growth and any level of service one could conceive of.

You can get there incrementally. I think what all of us are going to see after people get through the kind of star-gazing phase is just that kind of incremental approach where you go in and you first replace jointed rail with CWR, you upgrade the signal system, you upgrade the crossings, you build the facilities necessary at either end to service the trains and you design into the system the capacity that you feel you are going to want. You try to do this a piece at a time.

If one looks at what you could do with a corridor like that and where you get the biggest bang for your buck, you work on two areas. You work on speed and in particular you look at the low range speeds. You look at places where you are presently running 10 or 20 and where you can raise the speed up to 40 or 50. You also look at those things which would tend to improve the reliability in the corridor.

Control points and reverse signaling is exactly the way to go. That's what you do. The interesting thing about that corridor is that it presently has triple and four-track means in the Oakland terminal area already. They are there as a resource and they are there in a way that allows us over time to put them into increasingly higher use as the level of service increases.

I want to go for a minute to what things you should do and what you should all look for as you go forward with planning and design and ultimately construction of the improvements for high speed rail. First, you need a strategy for where you want to go. You need to decide on a corporate level what it is you want to achieve.

We view this by the way as an opportunity for us. We have corridors that are not highly utilized and we see this, if properly managed and properly designed, to be a major opportunity for Southern Pacific and for most of the freight railroads in the country in general.

We find that we were much better off to get in on this early rather than late. You need to work productively and constructively with consultants and the agencies that are going to be involved in designing and recommending and the agencies that are going to be involved in the funding.

You need to be real. You can't go out there and build a gold-plated system that you can't justify. So you have to have a realistic view of what it is that you need both to make yourself whole and to provide for the additional capacity you might think you need.

You need to protect yourself against risk. Almost above everything else, I think the major negotiating stumbling block that most of us will have as we go forward over the next 10 or 20 years to develop these systems is going to be to develop a fair and equitable approach to liability. I think an awful lot of time and energy and an awful lot of negotiation will go on to enable us to achieve this climate.

Finally, again, I urge all of you to look at this as an opportunity, not a burden. It is going to keep a lot of you busy for the rest of your careers. (Applause)

Mr. Van Huis: Thank you, Mike.

Before our next feature, I'd like to give a personal thanks to Jim Michel for his contributions and ideas and suggestions for the special features of this year's convention. Jim provided me with numerous articles and contacts from which to draw and for that, Jim, I thank you.

At this time I'd like to introduce Tom Reilly, western regional manager for the M.F. Bank Restoration Company in San Francisco. Tom is here to speak in place of Jim McGovern who is on assignment in the Midwest due to the floods.

Tom has been with M.F. Bank Restoration for 10 years and he runs the company's operations and oversees assignments in the 13-state western region. Tom holds both a Bachelor of Science and a Masters degree in psychology.

This morning's presentation will focus on an overview of what a full-line restoration company does to physically assist putting a business back in operation following a catastrophic event. Particular reference will be made involving M.F. Bank Restoration Company's role in getting the World Trade Center reopened following last February's terrorist bombing. Tom.

AFTER THE FIRE

Thomas Reilly

M.F. Bank Restoration Company

Thank you, John. Last week I was informed that I would be replacing Jim McGovern as a speaker here and I know he is up to his eyeballs in muck in St. Louis right now with the floods.

I like to know what kind of audience I speak to so I did a quick survey on this organization and membership. I found that five per cent of you have extremely high IQs and will probably be extremely bored with what I have to say. Another five per cent of you have extremely low IQs and will not be able to follow what I'm about to tell you. Eighty per cent of you, I discovered, are just going to sit there and daydream about sexual fantasies and not have any idea what I'm talking about. (Laughter) So I'm going to speak to the ten per cent that remain.

If I appear to be a little bit nervous up here it's not because I mind speaking to large groups. I'm just not used to working in buildings that have the electricity still on, have the roof intact overhead, have toilets that flush, and be able to breathe the ambient air without the use of a full-face respirator.

Our company, M.F. Bank Restoration, goes to work immediately following disasters after CNN News and the fire trucks leave. We are a nationwide disaster recovery company. Now, in the last year and a half this country has witnessed a lot of natural and man-made disasters, both large and small. You may even recognize some of them. Hurricane Andrew, Hurricane Iniki, the downtown Chicago flood in March, 1992, the L.A. riots, the World Trade Center bombing last February and, of course most recently, the Midwest floods which you have already seen something about today.

In addition to these, there are countless scores of hundreds of other localized disasters that happen every day that don't make the national news. Our company has worked on all of these. Some simultaneously in the case of the two hurricanes hitting at the same time. I even volunteered to spend two illustrious months in Kuwait following the Persian Gulf war consulting on the smoke contamination by the oil well fires.

There are a lot of public agencies out there concerned about saving lives and minimizing injuries and rightfully so. That's the first order of business. But after the event happens, the survivors must survive and that is also true in the case of businesses, government agencies, and so on. Companies must get back into business and get beyond the negative event that put them out of business. That is where we come in. As a matter of fact, our corporate motto is, "Our business is putting you back into business."

So why am I here to speak to you since we really have nothing to do with the nation's railroads? Well, I think everybody in this room and everybody in the country realizes that there is more to the nation's railroads than just trains and tracks. There are buildings, there are offices and there is a very sophisticated communication equipment system.

There are five main areas that we specialize in to physically get business properly restored and get them back into business. First, we deal with the structure and general contents. By general contents I mean the furniture, fixtures, the business equipment, and so on. In all these areas that I'm talking about, it only applies if it's restorable in the first place. If a fire does a good job and destroys everything, there is nothing to restore. If a flood wipes out a building, there is nothing to restore. But that's rare except in the case of all the thousands of feet of track. There is usually something left after a catastrophic event. Whatever is

left needs to get back into its pre-disaster condition. That cuts down on downtime and saves money.

The second area that we get involved in is with heating, ventilation and air-conditioning systems after fires. A lot of times there will be a small, isolated fire on one floor of an office building but yet the entire 20 or 30 floors of that building will be contaminated by smoke.

The third area that we deal with is in book and document restoration. This is the drying of vital documents and deodorization after fires.

The fourth area that probably most has to do with the people in this room is we specialize in high tech decontamination of corrosion after fires and/or water. We work on everything. Our technicians work on everything to control corrosion from the PC on your desk, all kinds of electronics, control consoles, communication systems, switch gears, and equipment of all kinds.

Then the last area that we have is we have a hazardous materials division which handles everything from PCBs to toxic cleanups.

In all these areas that I have mentioned, our goal is to work to reduce the gross loss through downtime and saving business property. M.F. Bank has been in business for 75 years working in post-disaster recovery.

Incidentally, M.F. Bank has nothing to do with the financial institution. It happens to be the founder's name. We are now fourth generation. We work for over 200 commercial insurance carriers worldwide and in private companies nationwide and overseas as well. We are based out of Atlanta, Georgia. I bet nobody in this room has ever heard of us. Has anybody ever heard of M.F. Bank Restoration Company? Not one hand. That means you have hopefully all been pretty fortunate and not had a major disaster affect you. But that's exactly why I am here today.

We speak to several groups like this because we think it is important that managers, technicians, and engineers who hold responsible positions in their respective companies know ahead of time that there is a company out there that can help you get back into business. Don't get me wrong. This is not a sales pitch for our company. We don't even charge until something happens to you so hopefully none of you will ever see anybody from our company.

At the risk of sounding morbid though or scaring the hell out of you, I want to stress that a catastrophic event can happen to your work areas. We have 24 field offices around the country. Every one of them is working on some other guy's problem every day. So there are a lot of other guys out there that have problems with fires and floods and so on.

We want to emphasize that if you realize something can happen to your business to put you down and out of business temporarily, it works a lot better if you plan ahead and foresee the worst that can happen.

In the past few years there has been a heightened awareness by both the private and public sectors for contingency planning in disasters. We have been asked by several companies to be the restoration contractor of record. It is actually written into their contingency plan in the event of a local or regional catastrophe.

As an example of the contractor of record program, I'm going to introduce you to two gentlemen via videotape that I have. The first guy, Nelson, is the risk manager of the New York/New Jersey Port Authority who owns and operates the World Trade Center complex as well as LaGuardia and Kennedy airports and Grand Central Station. The second man, Ed, is operations manager of the World Trade Center.

Back on February 26, both of these guys were eating lunch in their respective offices in the World Trade Center Towers of Manhattan. Before they had a chance to finish their sandwiches, they both heard a muffled explosion from the terrorist bombing and their offices immediately filled with smoke. The smoke in the Trade Center Towers as you saw on TV looked like it was all limited to the basement subfloors of the structure. Well, it wasn't all limited and escaping out the garage doors and so on.

There are 22 banks of elevator shafts in each of the two towers. These elevator shafts act just like chimneys in the event of the explosion in the bottom and there was a lot of smoke also in the ventilation system. Some of the ventilation system did not shut down especially in the tower that was not immediately over the explosion. Smoke was carried up through forced migration into all the air duct systems. The third area where smoke came from were the emergency stairwells which work great for saving lives, but they are really hell on distributing smoke.

With 40,000 employees attempting to exit these two towers through the emergency stairwells with the doors being open on every floor and people escaping each floor and moving down the stairwells, the stairwells filled with smoke. Consequently all of these means of migration caused just as much fallout of soot on the upper floors such as the 110th floor as it did on the third and fourth floors. Every square inch of those two towers internally was soot-ed up.

I'm now going to show you this video that we had professionally done. We are the contractor of record. After Nelson and Ed made it out of the building, we received a call within 90 minutes. We knew that this was the largest business complex in the world and we just happen to have been signed on as their contractor of record.

We were given the task by Governor Mario Cuomo's offices and the World Trade Center and Port Authority to put those buildings back inhabitable in 14 days. It actually took us 16 days once we got started because we had two days of downtime. We had 3,400 employees a day working this project and for two days we had a bad blizzard in New York and only 800 employees showed up for work.

I'm going to continue now with the movie. It should last about 15 minutes. Again, it is not meant to be an advertisement for our company. It is meant to show the relationship of being prepared ahead of time and knowing what your resources are. It will show the interesting interaction between the World Trade Center as a company and as the victim, so to speak, in this case and us as a recovery firm. Unfortunately, it doesn't show a lot of detail about our high tech capabilities and some of the specialized areas that we deal in. I hope you enjoy it and hopefully there will be some time for questions at the end.

(Whereupon there was a video presentation)

I just wanted to add that a year before the terrorist bomb, the Port Authority had never heard of us either. You can see it was an enormous project. It is one that we are obviously proud of or we wouldn't have had this glowing testimonial video done. But more importantly, it shows that preplanning is important.

There is obviously no way you can preplan a terrorist bomb, but buildings have fires, planes crash into highrises and things of that nature do happen. The more proactive a company can be in their contingency and disaster planning, the faster they are going to get back on their feet. I just ask that if any of this happens in areas that you work in, you give us a little more leeway instead of the 14 days for 220 floors. Thank you very much. (Applause)

Mr. Cantrell: Thank you, Tom. That was very informative. We never know when something like that is going to happen.

For the next presentation, it gives me great pleasure to have the opportunity to introduce a couple of individuals. It is always nice to run across people that walk the talk. I think that Ken Sito and Windell Pyles do just that.

Ken is chairman of the Special Subject No. 1, "Quality," and Windell is his co-chairman. They are going to give a joint presentation on that topic today.

Ken has been working for the Union Pacific Railroad for 18 years. He started as roadmaster in Chester, Illinois, and has held various jobs with the Union Pacific since. He is out of Omaha.

Windell Pyles is a second generation railroader and has been with the Southern Pacific for 28 short years. He has held various jobs in the track department, laborer, foreman, student

foreman, assistant foreman, track foreman and the present job that he now has is manager of quality for the engineering department for the Southern Pacific.

It does give me great pleasure to introduce these two gentlemen. We most definitely want questions. Just because you don't see any microphones standing up out here, doesn't mean we don't want questions. We do have the portable mikes to hand to you. You can ask the question and remain seated.

At this time, I'd like to introduce Ken and Windell.

SPECIAL SUBJECT NO. 1

Quality – Is It For Everyone?

Chairman: Ken Sito, Manager Engineering Services, Union Pacific, Omaha, Nebraska

Co-chairman: Windell Pyles, Manager Quality, Southern Pacific, Roseville, California

Mr. Pyles: Sometimes the smallest improvements can make a difference. Take, for example, the track team that believed the drill bits supplied to their gang were not as high a quality as those available on the market. After using the problem-solving process and compiling results, the team instigated a change in the standard rail drill bit that was being purchased by their railroad. The higher quality drill bit that is now purchased has improved productivity and reduced material purchase expense. The estimated savings per year because of this team's efforts is \$285,000. Ken, is that quality?

Mr. Sito: Well, Windell, when I was first introduced to quality management, I understood the importance of performing quality work, but I didn't see the need for all the activities that seemed to surround it. I was even surprised when it was selected as a topic for this conference.

Field supervisors such as our audience have too much to do and too many projects to complete. They have rail to lay, ties to install, track to surface, and a host of other projects, not to mention the responsibility for track inspections, safety meetings, and the administrative bureaucratic paperwork that comes with the territory.

So why would they ever want, much less endorse, another trendy new-age management process developed by someone who probably has never worked for the railroad much less in the railroad maintenance area? I mean, we are different, right?

Ladies and gentlemen, Windell, my co-chairman, and I realized that we needed to find out what railroad managers thought about quality management so we mailed surveys and questionnaires to 12 different railroads to solicit the field supervisors' perception about quality. To those of you who responded, thank you. Your responses and stories provided valuable information for our report. I would also like to thank Pat Walsh and Jackey Pratt for their efforts with our presentation.

Now for some of the highlights. First, of the 12 railroads surveyed, all indicated they had a total quality management program in place or were establishing such a program. This was substantiated by the AAR Council on Quality. The railroads that have quality programs or were beginning to use total quality management indicated such programs were being introduced by way of training using a top down approach in their respective organizations.

Those railroads who indicated they had an effective quality program in place spent a significant amount of time teaching managers on the problem-solving process.

Our quality programs, like many in the other industries, are based on the Deming or Crosby philosophy with several modifications and combinations to suit our operations. Through problem solving, team leadership and facilitator training, as well as improved managing with data, we have now begun to prepare our transition into quality management.

Quality management is gaining acceptance and the railroad industry is benefiting as training is extended from the vice-president of engineering and chief engineer down into the organization to the bridge and trackmen.

Ninety-four per cent of the respondents indicated that the quality process improved the effectiveness and productivity of their workforce. Reduced training delays, improved safety in the workplace and a stronger focus on meeting customers' expectations were frequently cited as examples attributed to quality management.

Mr. Pyles: There is the story of a team that worked on the problem of maintenance ties that needed to be unloaded by hand when delivered to the section making it unsafe and time consuming. Using problem solving, the team analyzed the process and the needs of the section gang and then brainstormed for different solutions.

The team proposed that maintenance ties be banded together in multiples of 25 when shipped to section gangs. This was approved by the steering committee and implemented. Section gangs are now experiencing reduced exposure to potentially hazardous conditions and experience a reduced tie unloading time from eight hours to two hours.

Mr. Sito: Another example of an improvement area cited by the supervisors was in resolving work-related problems. Seventy-one per cent of the respondents believed the quality process was effective in improving communication among employees because the employees used a common language when using the problem-solving steps. The respondents indicated they were least effective when middle managers perceived that they were being excluded from decision making.

So what about long-term prospects? Is quality management here to stay? Over 88 per cent of the respondents believed the acceptance was good and the quality management process would remain in their respective organizations.

What about the effectiveness of using the process to address safety issues? Eighty-one per cent believed safety has improved and many problems previously viewed as untouchable or insurmountable are now being addressed and solved.

Mr. Pyles: The efforts of a rail gang's quality team is helping improve safety and efficiency in rail-cutting operations. What once required three to four employees to free a 26-inch rail saw blade after binding in the rail during cutting operations can now be handled by the operator in seconds. The team developed a hydraulically-operated jack mounted on a large O'Bear rail saw to safely raise the saw blade when the saw blade is lodged in the rail. Their efforts have reduced employee exposure to potential back-related personal injuries in such situations.

Mr. Sito: That's going after a hard problem. Now back to the survey. When the respondents viewed the senior manager's position in supporting quality management, 75 per cent believed management was supporting the process, but feared senior management wouldn't walk the talk.

However, there was a strong, growing feeling that senior management is becoming much more visible and getting more personally involved. Now, you may wonder what the survey results said about middle managers' concerns. Although there was a concern that quality would be too costly and time consuming, 67 per cent of the middle managers favored the processes. Among those components cited as most effective for field managers, the first is employee involvement. This provides a common language and process to solve problems.

Mr. Pyles: There was a welding gang that wanted nothing to do with the team concept

of quality management, but was tired of being exposed to the heat and fire of the slag pan while making field welds. Working together and using the problem-solving process, they developed the slag pan removal tool that will be standardized across the railroad.

The welding gang members have now requested increased quality training to resolve additional problems in their workplace.

Mr. Sito: Another component cited by middle managers was the problem-solving process. This improves the ability to get to the root cause and solve hard problems.

Mr. Pyles: The beauty of the quality process and the team concept is that it helps employees break through the, "that's the way we have always done it," syndrome that impedes innovation and the finding of real solutions.

Take for example the team that worked on reducing false restrictive signals. The team's analysis of the problem showed that during a six-month period in 1991, 24 per cent of the false restrictive signals were caused by slide detectors. The team also found one slide fence location attributed to 55 per cent of the delays. This location stopped approximately 100 trains over the six-month period.

Further analysis showed false restrictive signals were caused by small rocks falling and breaking the slide fence wires with the majority of the breaks occurring within three feet of the ground.

After exploring the cost to chain and pin the hillside and receiving estimates between \$300,000 to \$1 million, the team decided to explore other options. The team's ability to look beyond boundaries helped them explore the use of reinforced concrete barriers such as those used to separate traffic lanes on freeways. The cost of each 20-foot concrete section was \$150. The result was an 80-percent reduction in the number of false restrictive signals at that location.

Mr. Sito: That's using the process. Another component is customer focus. This ensures that we understand our customers' needs and our responsibilities in meeting those needs.

Mr. Pyles: You know, when I think of the focusing on the customer, I think of a team that addressed injuries in a switching yard that were associated to lining switches. The track maintenance team analyzed switch-related injuries in the process of switch maintenance. They looked at many conditions and root causes. With the approval of a steering committee, the team implemented the solution of adding a switch maintainer to the maintenance-of-way workforce. His sole responsibility was to lubricate, adjust, and properly maintain all hand-throw switches in the terminal. The team's post evaluation showed that the personal injuries associated to switches had been reduced by 80 per cent.

Mr. Sito: Yes, Windell, that's customer focus. Those individuals who responded to this survey believed very strongly in the benefits of the quality process. Eighty-eight per cent agreed it gave employees more empowerment on the job; 94 per cent agreed employees must be knowledgeable of the quality management concept to use it, while a similar percentage indicated quality process training was time well spent. Also 82 per cent believed the meetings were very productive.

Is this a clever way to reduce the workforce? Ninety-four per cent said no.

Is this a passing phase for the industry? Ninety-three per cent said absolutely not.

Ladies and gentlemen, quality management systems are gaining a strong foothold in the railroad industry including the maintenance-of-way area. If quality management systems are to become truly effective, four quality principles must be consistently and constantly practiced in every organization. They include: customer satisfaction, managing with data, continuous improvement, and team work.

Your customer is the recipient of your outputs or work efforts. The customer may be either internal or external to your company, but ultimately your efforts must satisfy them.

Three basic steps exist: Determine who your customer is. Determine your customer's requirements. Frequently ask your customer whether you are meeting those requirements.

We must manage with data. This is the only foundation from which all decisions and actions are made.

Mr. Pyles: You know, there is a story where an engineering department incorporated quality management into their safety program. They analyzed the causes of personal injuries and found three top categories to be slips, trips, and falls; handling materials by hand; and the use of track tools. They also identified items in each category that contributed to the highest percentage of incidents.

For instance, slips, trips, and falls occur most often when operators were getting on and off roadway machines. The problem were steps, handholds, and the deck surface.

Incidents that were attributed to handling material by hand occurred when an individual was setting spikes by hand on a curve gang.

The track tool that was involved in the most injuries was the claw bar.

After identifying the root causes, the team continued applying the problem-solving steps to develop solutions. The solution for slips, trips, and falls required ergonomic design of decks, steps, and handholds. Handling materials by hand resulted in a joint venture with a vendor designing a curved gang auto spiker. The track tool category resulted in redesigning the claw bar.

Through the team's efforts, their department has achieved an average of 22.5 per cent per year reduction in personal injuries over the last four years.

Mr. Sito: Windell, that was a great example of managing with data using accident analysis, observation, problem solving, employee involvement, and vendors in a quality management process.

The third principle is: plan, do, check, and adjust. I am sure many of you have seen or heard something similar to this before. Today's business environment demands we operate by constantly looking for continuous improvement; even small ones.

Mr. Pyles: Right, Ken. You know recovering bridge employees after a fall is easier, thanks to the efforts of a bridge department quality team. Although fall retrieval devices exist, a team found them to be either too costly or time consuming to use in the field. Using the problem-solving process, a team developed a retrieval ring to be added to the lanyards near where it is secured to the bridge. Should a person fall, the hi-rail boom truck and hoist will hook into the lanyard ring to retrieve the fallen victim.

The new system represented a cost savings of \$4,300 per gang and the retrieval is faster and safer. Ken, is that continuous improvement?

Mr. Sito: Yes, that is.

Team work, like the other principles, is a way of thinking and acting. Every organization must foster the mindset that employees can resolve work-related problems together. This leads to continuous improvement and ultimately satisfies the customer.

How do you foster such an environment? Simply put, employees need and want to know where they fit into the big picture in your organization as well as what their responsibilities are. To accomplish this, you must train employees. This means training everyone and, in many cases, more than once. Most importantly, don't forget the middle managers. They must be taught how to work with quality management and how to coach employees. You must build trust by fostering free and open communication among employees and you must give employees the responsibility and authority to do their work.

Mr. Pyles: You know when a quality team first began analyzing the problem of poor quality rail saw blades, they knew it was a perfect opportunity to prove the railroad management was purchasing low quality saw blades.

After working through the problem-solving process, the team identified the root cause as a failure to follow standard operating procedures for rail saws. By implementing the problem procedures, the team reduced rail saw costs 66 per cent over a six-month period. The gang now makes five to six cuts per blade compared to the previous one to two cuts representing a savings of \$265 per month for one gang.

Another success story was about gaining access to material box cars. This is now easier thanks to the efforts of a system rail gang quality improvement team. The team developed a light weight aluminum detachable access ladder to safely enter and exit most box cars. The team's innovative ladder design was constructed according to OSHA requirements and also attracted the attention of several other Class I railroads for their own use, indicating a potential benefit for the entire railroad industry.

Mr. Sito: Teamwork must be an operating standard just as standard gauge is 56.5 inches. I know buying into quality management is somewhat like asking you to take a leap of faith.

Mr. Pyles: Wait a minute, Ken, you're talking about a leap of faith and that reminds me about a roadmaster inspecting track up in the mountains who slipped and fell off the side of a cliff. Fortunately, he was able to grab hold of a tree growing out of the side of the mountain that the sprayer had missed. As he dangled 1,000 feet above the rocks below, he began yelling, "Help, help. Is anybody up there? Is anybody up there?" Then came a response from the sky, "Yes." The roadmaster screamed, "I need help! Please help me!" The voice in the sky asked, "Do you believe?" The roadmaster responded, "Oh, yes. Yes, I believe." The voice from the sky then replied, "Then let go of the bush." The roadmaster responded, "Help! Help! Is anybody else up there?" (Laughter)

Mr. Sito: I know letting go is difficult, but as we have shown today, the quality improvement process works and it is effective.

This is the end of our presentation, but not the end of the story because quality is a never-ending story. (Applause)

Mr. Cantrell: Very well done. Thank you both.

After you heard this presentation, you will have to ask yourself whether quality is for everyone. Are there any questions? If not, I will turn it back over to Ken Welch. Thank you, very much.

President Welch: I have one announcement on our attendance. As of 11:30, we now have a total of 2,608 registrants of which 509 are spouses so I still think we are at record pace.

This session is now adjourned.

TUESDAY MORNING JOINT SESSION

September 21, 1993

President Saletnik: The second joint session of the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association Annual Conference will now come to order.

First of all, I have a couple of announcements. The current total registration is 2,010 with 506 ladies for a total of 2,516, which is a very successful conference.

There will be a tour of FAST track at 9:30, Thursday morning. If you are interested, please see Warren Peterson in AAR Booth No. 614. Lastly, the video training room has been moved to C212 which is right across the hall.

Pride is the key word for me this morning. Jerry Hines stated it yesterday morning. As members of the railroad industry in America today, we all should share a sense of great pride. Over the past 20 years, our industry has been an example of how change can be utilized as an effective route to improving service to our customers to increase efficiency and productivity.

The drastic changes which were initiated in our corporate board rooms to reorganize, consolidate, and rebuild American railroads have put our industry on a stable and sound foundation for the future.

But what about the future? If we are to further improve, is the answer for meeting the challenges into the next century based upon more consolidation and further pruning? For some railroads that may still be a viable way to go.

What about those of us who now take great pride in the fact that we are survivors and members of that proverbial lean and mean machine? How do we further enhance our productivity and efficiency? How do we turn that throttle up one more notch so we make ourselves more competitive and more responsive to our customers' needs than those of other modes of transportation? The answer can no longer be prune but rather sharpen. We must sharpen our skills and maximize the benefits obtainable within our current resources.

How is this best accomplished? As we saw yesterday, it is through thorough quality planning and teamwork. As Stan McLaughlin said yesterday, the real power is in the hands of the people who do the work.

With this in mind, I'm proud that the Board of Directors of the American Railway Bridge and Building Association has decided to set an example. Later this morning during our business session, we will be voting on a proposed constitution change. That change regards membership. The proposed change will broaden the base from which we draw our members. This change will invite those who do the work to participate and share their ideas as an equal team member. For if we are to achieve true quality, the whole team must have an opportunity to contribute. If we are to achieve true quality, the whole team must also have proper skills.

In addition to our normal conference activities, three years ago the B&B Association created its first training seminar on contract administration. In each of the past two years we have conducted two comprehensive three-day seminars on bridge inspection. Continuing this effort, I'm proud to announce that we will conduct one more bridge inspection seminar early next spring and present a new bridge repair seminar late next fall.

The most successful railroads of the next century will be those that are most adept at being able to respond to change while maximizing the benefits attainable through the use of their existing resources. This also holds true for our associations. Much of our thoughts over the past few years have been focused on self evaluation. For it is through communication

efforts and accurate evaluation that we learn where to sharpen and where to improve.

I therefore ask all of you to get the programs that are in the back of the room. In there is an insert of a conference survey. I would ask all of you to fill one out and return it to the registration desk. If you have other comments or suggestions, please don't hesitate to voice them.

We welcome good, constructive criticism. You can talk directly to any one of our Association board members while you are here at the conference. You can call our Homewood, Illinois, office and talk to Pat or Barb or you can even write us a letter. But we need to know what you are thinking if we are to respond to your concerns.

I am also proud to have served as president of the B&B Association and proud to be a part of a railroad company that has proven that we are adept at responding to the demands of a highly competitive transportation marketplace.

Over my nearly 20-year career at the Chicago and North Western Transportation Company, we have gone through many changes. During the past 20 years, our company has made a great turnaround. That turnaround has been made possible because the Chicago and North Western has been guided by several very dedicated team leaders who will not accept business as usual.

This morning I am proud to introduce to you the team leader of our engineering department, Mr. Dennis Waller, vice-president, engineering and materials. Dennis graduated from the Illinois Institute of Technology with a Bachelor's degree in mechanical and aerospace engineering and received a MBA from IIT Stuart School of Management. He began his railroad career in 1966 as an apprentice for the Soo Line in Minneapolis. He joined the Rock Island in 1971 and became general superintendent motive power in 1976. In 1979, Dennis left the Rock Island to become superintendent of motive power for the Chicago and North Western. He has held the positions of assistant president of motive power, vice-president materials, and vice-president motive power and materials. Since October, 1990, he has held the position of vice-president engineering and materials.

Dennis has professional affiliations that include the American Society of Mechanical Engineers, the National Association of Purchasing Management, AAR Research and Test Committee, and the AAR Engineering Management Committee.

I first met Dennis Waller when he was the superintendent of motive power. At that time we were in the very early planning stages for a major shop complex which was to be built in Nebraska. Yes, I said "was" because we never built that facility, at least not as it was originally perceived. Why? Because Dennis and the other Chicago and North Western team leaders were constantly reevaluating and reassessing what we had to accomplish and how best to do it.

Mr. Waller is an individual who will not allow us to get stuck on our own paradigms. He is always there asking the tough questions and forcing us to reevaluate our approach. Today he will share his insight and approach to maintenance-of-way activities. Please join me in welcoming Mr. Dennis Waller. Dennis. (Applause)

KEYNOTE ADDRESS



Dennis Waller

**Vice President Engineering and Materials
Chicago and North Western Transportation Company**

Thank you, Paul. I appreciate those kind words. I wasn't sure what Paul was going to say this morning but your raise will be in the mail. (Laughter) I want to thank everybody for getting up this early in the morning both to come and see the CRASH program as well as to start the beginning of these proceedings.

My first thought and my first comment before I start my formal comments this morning is that much has been said over the past several years about shadow organizations in the railroad industry. Well, if a 2,500 attendance at a meeting like this is a shadow organization, I guess I'll eat my hat. I think this shadow organization is certainly alive and well.

Paul, again, thank you. I appreciate those kind words. I don't know if Herb is in the audience this morning, but in large measure I owe an awful lot of the detail in my comments this morning to Herb Clark who assisted in giving me some insights. I also see quite a few North Western guys around here. As a matter of fact, I think all 14 of us left in the department are here at the meeting today. We are certainly privileged to be here and I mean that. I am privileged to be able to share some thoughts with you today.

Stan McLaughlin's keynote address yesterday was excellent. It addressed the level of involvement necessary by each and every maintenance-of-way employee in achieving the results demanded by today's operating environment. He really said it all yesterday with respect to the need of current day organizations to tap the ideas, experience, intellect, and involvement of willing team members. It truly is a route to success needed by the ever-increasing demands placed upon the railway maintenance-of-way function. I would like to build on the premise that Stan started yesterday.

First some sobering historical comparisons. I think we need to set the stage for where we are today. In 1947, the United States was regearing from a wartime economy. The earliest track machinery designs were coming on board at the nation's railroads including air-operated surfacing equipment. Competitive pressures were beginning to really take hold in the American railroad industry.

The railway passenger business was being challenged by air and bus and the freight business was beginning to see the major challenges by the trucking businesses. The pre-war depression consciousness of America was replaced in 1947 by the post-war free-market consciousness. The railroads' market share was being challenged. Finally, the post-war inflation began to nibble at the bottom line and thus began the do-more-with-less era that the railroads have succumbed to ever since. Most especially, the do-more-with-less thinking that the maintenance-of-way departments have had to put up with.

For example, the total United States track miles operated in 1947 was 398,000 miles. In 1991, it had shrunk to 196,000 miles. The miles operated were cut in half in 45 years. The total maintenance-of-way employees including structures in 1947 was 264,816. Take a look at the total railroad employment today. In 1991, that 264,816 had shrunk to 34,877. Imagine that. The 1991 level of maintenance-of-way employees was a mere 13 percent of what it had been in 1947.

The annual tons originated by the railroads in 1947 was 1.54 billion tons. In 1991, it was 1.4 billion tons. Pretty steady, but I think in that time all of us are aware of the fact that the industry has shifted to more bulk and certainly heavier and more concentrated loadings in terms of our transportation.

Crossties

The crossties that were installed in 1947 numbered 40 million. In 1991, the industry put in 12 million crossties. The average crossties installed per employee in 1947 were 160 per year. In 1991, they were about 400 per employee per year. That's almost a threefold increase in productivity. This could not have been done without the development of the ancestors of the machinery that we see here today at the show.

Surfacing

It was common in 1947 to have 110-man manual surfacing gangs. Today, three to four-man machinery-assisted gangs do that and much more work. In 1947, only some air-driven tampers were beginning to appear on the scene. What about the track structure? How was it loaded? How was it impacted by the type of equipment that ran on the railroad?

Well in 1947, the standard boxcar was of the 50-ton variety. The 70-ton car was starting to achieve prominence and starting to be purchased by the railroad industry. In 1991, the 100-ton car is commonplace with the average tonnage per freight car on American railroads today being over 85 tons per car. So in 1947, the axle loadings on our track structures were in the order or magnitude of 20 to 25 tons per axle. This has steadily increased to over 33 tons per axle and soon to be 36 tons per axle as we move into the era of the 286,000 pound carload. In the next century, there is no doubt in my mind that the 125-ton car will be here.

So the physical demands on the track structure and bridges is ever increasing and has been ever increasing. That's the story of productivity in our industry, allowing no margin for a leave-it-for-tomorrow attitude or thinking regarding maintenance.

All this has been occurring with an aging and, I might say in some cases, a rapidly aging infrastructure. Tons of new rail installed in 1947 totaled 1.64 million tons. In 1991, only 299,000 tons of new rail were installed. The 1991 level of new rail installation is about 18 percent of what it was in 1947. In that same period of time if you will recall, the average rail weight was adjusted upward by some 18 percent from the standard 112 of that era to the current 132 and 136-pound rail.

The prediction here for the 21st century is, and this is for any of you rail suppliers out there, a pent-up demand. As my boss likes to say, the elevator is going up. So I think those of you who are in the rail supply business certainly can see that as we are looking at the heavier axle tonnages, if we are looking at increasing volumes and shrinking railroad infrastructure and the maintenance and new rail levels that we have seen over the past, our structure is pretty much going to wear out and start having to be renewed on a grand scale later in this decade. I hope we are all prepared for it.

Finally, the average miles maintained per maintenance-of-way employee was about 1.5 miles per employee in 1947. Currently it is about 5.6 miles per employee. Again, almost a fourfold increase in productivity in 45 years. All this productivity increase and this better utilization of equipment and manpower has taken place while FRA mandated track standards have come into being to monitor compliance through the 1990s.

Surely it is obvious by now that something amazing has happened over the past 45 years. What is it? Well, I'm going to submit to you that it is simply the creativity of the maintenance-of-way management over the past 45 years and the successful alliance, and I hope you will note that word alliance, between the railroads and the railway supply industry. This is all brought about by the demands placed upon the railroads by the markets that we serve and, in turn, the demands that the railroad industry has placed on its suppliers to meet its productivity goals.

We are here because of that alliance. I think that was summed up yesterday by some of the speakers including REMSA and so forth in which they talked about how critical and how crucial the alliance between the member railroads, the AAR, REMSA, and all the technical associations are in making these things happen. I think if we look back over these past 45 years, the reason the rail industry is as healthy and prosperous and as forward-looking as it is today is simply because of the fact that these alliances have been effective over the years and I hope will continue to be effective to bring us into the 21st century.

Let me digress for a second and talk just briefly about something that kind of amuses me when I put my purchasing cap on. I can look at Time magazine or Newsweek or Business Week or any of the Sunday newspapers and find nice, big articles about how the current steel and automobile industries have discovered partnerships with their suppliers and have a partnering arrangement and use more out-sourcing. In most cases, they are saying this is the greatest thing since sliced bread that has happened.

One of the things that brings a smile to my face is the fact that the railroad industry has always enjoyed this kind of a partnership and this kind of wonderful alliance between its suppliers and the members that make the railroads work. I think we, both as railroad employees and as supply members, need to be very happy about that alliance.

What I try to build with these statistics is the notion of the need the railroad industry has, especially the maintenance-of-way function, to continue to be partners with our suppliers and to achieve efficiencies that are being demanded of us. The challenge has never been greater for maintenance of way as we move to the 21st century.

The demands are tough, but I think as we have seen from our historical past, these demands are achievable. I see these demands including tighter maintenance-of-way budgets, increased levels of federal and local involvement in almost every aspect of our activities, track standards, track safety, environmental requirements, employee safety. The list goes on and on. You probably can give a much better list than I can.

We are also looking at increased axle loadings up to 25 percent in our future. We are looking at higher track speeds for mainlines and we are looking at mainlines in which the market demands are now at work to force premium or specialty unit-type trains at high speeds to share rights-of-way with heavy load, heavy axle, heavy haul unit trains and perhaps, yes, even some high speed passenger trains.

The railroad in our very near future is not even quite what we are experiencing now and

I think we have to get our minds set to the fact of what is going to be required in order to create those railroads for an environment in which we are going to be living.

Additionally, reduced on-track time for maintenance is a way of life for all of us. The one thing that the railway supply industry has to continue is its excellent record of machine unit productivity increases and maximum travel speeds to get this equipment in the clear.

Finally, there is increased expectations by Americans to be not only environmentally conscious, but environmentally aware and environmentally responsible. Chemical treatments, tie disposals, and just plain dust won't be tolerated in our futures. We have to recognize it and we have to deal with it. I think we will make some tremendous strides and gains over the next few years in these areas.

One thing is certain. These demands are not going to decrease. They will surely intensify as we move into the 21st century. But, and here comes the good news, the resolve has never been greater. The resolve by the men and women represented here this week, both railroad and supplier, who are responsible for and dedicated to providing the best private railway system infrastructure possible.

How is this resolve manifested? Quite simply in two ways. First, witness the array of topics that have been covered and will be covered by the papers presented at this conference. These topics are broad in their scope and they cover just about every aspect of industrial life that we could hope to cover. These topics include: employee safety, employee training, the triumph over physical plant destruction caused by the recent flooding in the Midwest, preparing for high speed rail, improving specifications for work equipment, meeting our environmental responsibilities, assessing future quality issues for maintenance of way, and improving machine reliability. Getting at the root cause of the derailments with train sets will surely be our mainstay of the 21st century, and finally, handling fuel safely and economically. These topics speak loudly about our resolve.

Secondly, I think we should note the unparalleled collection of technology which is on display here this week. The industry needs to meet the demands which will be placed on us and which are being placed on us right now as we enter the 21st century.

The exhibits of REMSA Technology 2000 are achieving the most vital aspect of this conference. Now, what is this most vital aspect of this conference? It is one word. Dialogue. It is causing railroaders and suppliers to communicate. To communicate, I might add, on a grand scale. This conference brings together the practitioners of railway construction and maintenance and the supporting supply personnel who have made and will make happen the great advances the industry requires. This conference will not be wasted if each of us takes the opportunity to dialogue and communicate.

We need to clearly communicate the limits, the time frames, the requirements, and the failures that we have had in order to encourage successful change. In short, this conference, in large measure, could very well make the critical difference in determining the future success of the railroad industry to meet our shippers' expectations. You can read that word as visions or whatever you want to read it as. But our shippers are being pretty vocal today, and not only our shippers at North Western, but I think shippers in the railroad industry, about what quality rail service is.

Do you hear all the buzzwords? Seamless, quality, et cetera. Our shippers understand that they are giving us a tremendous amount of money for the business that we are in and they are demanding an ever-increasing performance. We have to meet those requirements and challenges if we are going to stay in the business that we are in. The success, you might even read that word as survival, of tomorrow's railroad industry starts with each of us here today. We have an unparalleled opportunity at this conference to shape our requirements through the simple process of exchanging ideas. Ideas. That is what makes it work. That is what got us from 1947 to 1993. That is what created the finest, most responsible alliance, and I'm going to use that word again, alliance, between any industry and its supplier in the

history of the United States' economy. An alliance based on mutual goals, an alliance based on mutual respect, and an alliance based on shared vision of what must be.

This conference's focus is on technology, our need to develop it and our need to invest in it and for you suppliers out there, I mean invest in it. I'm going to digress for a second. You have gone to some great expense to market your wares at this conference and for those who are in here from the railroad industry, you need to beat on your purchasing guys and your engineering management to support the supply industry for the tremendous effort that has been shown at this show and behind the scenes and the R&D that has been put forth in order to make these exhibits work.

But while this conference really focuses on technology, we have to do something else. We also have to focus on and we have to invest in and we have to develop another element equally as important as technology and that is our human resources. If we are to benefit from the computer-aided track equipment, the high-tech safety equipment, and the technological explosion that we see all around us at this conference, we must take very special care to assist, train, encourage, and develop the human resources who will operate and maintain this increasingly specialized equipment.

I was very refreshed and heartened to see the real movement in the videos for establishing and maintaining training programs for increasingly sophisticated pieces of track equipment. That's right on in the industry and I know the industry has moved up on it. We need to move up on it ever increasingly to get this training done both for the operator as well as for the maintainer.

This, too, is part of Technology 2000. Let's make it part of our dialogue here this week and after this week. We have to return to our respective organizations with an intense commitment to develop the key human resources.

Finally, the alliance between your professional organizations, the Roadmasters and Maintenance of Way Association, the American Railway Bridge and Building Association, REMSA, the AREA, and the AAR research and test department must continue to focus on the development of what I will call turnkey technology.

Turnkey technology simply stated has a number of elements to it; one of which is the technology which will be necessary to eliminate the drudgery of the trackman. As an aside, I would personally rather see everybody in the engineering department operating in an air-conditioned environmentally safe and well-managed operators cab than out on the track throwing plates around and making himself susceptible to back injuries, lacerations, or anything else.

The time has come to put the final nail in the coffin, so to speak, in terms of the ability to put forth an injury situation for people that we have on the railroad.

Turnkey technology includes technology which will allow rail installation direct from a rail train. Turnkey technology will allow tie removal with new material transported to the jobsite and removal of spent material transported from the jobsite that same day.

Turnkey technology will allow surfacing and compaction to take place at higher speeds and generate uniform track structure resistance for any train movement immediately after that maintenance.

This will all happen, but only one way. It will only happen if your alliance, the alliance between the railroads, the technical and professional organizations represented here and the suppliers, and most importantly every person seated in this room and attending this conference, if each of you continues to do your job. You each must have the desire to make it happen.

While you are here, please learn, please ask, please talk, please offer ideas. We all must continue to make this alliance create the railroad industry to move us into the 21st century. Thank you. (Applause)

Mr. Saletnik: Thank you, Dennis. I would like to introduce Jim Michel, assistant vice-president design and construction for Amtrak. Jim is a past director of the B&B Association

and currently serves as our proceedings chairman. Jim has taken on a new responsibility as president of the Foundation for Railway and Transportation Excellence, a nonprofit organization organized to host the 5th International Brunel Awards Railway Design Competition in 1994.

Jim will acquaint us with the excellent opportunity to participate in this prestigious event which will increase the awareness of the public and our employees to the quality of the design that makes American railroading such a strong and technologically advanced industry. If you will, Jim.

Mr. Michel: Thank you, Paul. Good morning ladies and gentlemen.

In 1994, the fifth edition of the prestigious Brunel Awards International Railway Design Competition will come to the United States. Established in 1985 by the Watford Conference of European Railway Designers, the Brunel awards honor the legacy of one of the greatest and earliest railway engineers, Isambard Kingdom Brunel, of the Great Western Railway of England. He is probably noted for being one of the best dressed engineers of the railways as you can see by his top hat.

Brunel had a vision to connect London with New York with intermodal connections using the Great Western Railway and his own steamships at Bristol. He designed the Great Western as an integrated transportation system and many of his designs such as the Paddington Station still remain in service on British Rail to this day.

Embodiment of Brunel's vision is the idea behind bringing the Brunel back to the United States next year; a joining of two continents.

Brunel's competition is intended to focus both American and international public opinion on the strength of America's railroading industry. Hosted jointly by the Watford Conference, the Foundation for Railway Transportation Excellence, and Amtrak, the competition will allow American ingenuity and creativity to be entered into a world class competition.

There are 25 categories covering all areas of railroad design activity. In particular, we have established several engineering categories for bridges, structures, and buildings and these have been created especially for the 1994 competition to allow greater participation by North American railways. The visual images of quality design will portray American railroading as a second-to-none industry.

Today in this conference we have many of the best designers and design leaders of the industry. I ask you to please consider entering projects that have been completed since June, 1988, and up through May, 1994, especially in the bridge and structure categories. One example of a project that was entered in the 1992 competition in Madrid is a bridge on the Dutch Railways which is truly a design solution. It's a skewed bridge with two leads that go in opposite directions with catenaries and when they are all finished, the bridge when viewed from the side with those impressive counterweights offers a very charming and enhanced design.

Official entry forms will be distributed in January, 1994. Entries may only be submitted by railway companies who are affiliated with the AAR or IUC, the International Union of Railways. For those of you in the consulting industry, if you have done jobs for railroads that you think are worthy of being entered, you ought to talk to the client and get them to make the entry. The winners will be announced on June 27, 1994, and formal awards ceremonies will take place in Washington on October 18, 1994.

As part of the competition, there will be a traveling public exhibition of the entries and the models that go with those entries in major cities around the United States.

The Brunel competition is being supported largely by a volunteer committee of interested people. AREA Committee 6 will be joining the Brunel-Watford group when they come to the United States for a joint meeting in October and many members of Committee 6 have offered to participate in this effort.

On the table in the back as well as out in the registration area is a brochure if you want more information or you can contact the Foundation for Railway and Transportation Excellence.

I thank you for this opportunity to acquaint you with this event. We think it is going to be a real attraction for the public and for the industry as a whole and a good compliment to many of the quality employee programs that have now been launched around the country. Thank you. (Applause)

President Saletnik: Thank you, Jim. I would now like to turn the podium over to Darrell Cantrell, but before I do, as president of the B&B Association, I would like to personally thank Darrell and Don Steele. As our respective program chairmen, they are responsible for coordinating this conference and making it the success that it is. Thank you very much, gentlemen. Darrell.

Mr. Cantrell: I would like to add a little bit to what Dennis said. I think as we look around this conference in this room, out in the upstairs exhibits and the outside exhibits, we can really see the importance that REMSA plays in a program that is put together like this. I think it shows how important REMSA is to the railroad industry, but not only in the railroad industry, but to the Roadmasters, B&B, and AREA Associations. I think it is very important that REMSA stay alive and afloat. This panel discussion that we are just getting ready to see will point out some of the things that we have to have as an industry to keep us afloat and keep REMSA, the supplier people, in business.

Most people here probably don't know the panel moderator. Vin Terrill is sort of new to the industry. (Laughter) Vin started work on the Boston Maine just shortly after World War II in the Engineering Department and through a GI Bill he left the railroad for a short period of time and got a degree from the University of New Hampshire. He rejoined Boston Maine in 1952 and worked there until ending as vice-president in 1985. He has held about every kind of hat there was in the engineering department on the Boston Maine.

From 1985 to 1990, he was president and chief executive officer of Speno Rail Services. From 1990 to 1992, he was director of Pandrol North America Holdings Company. Vinnie is now a full-time consultant. He is also a member of the Roadmasters and Maintenance of Way Association of America and the past president of both REMSA and the AREA.

I will let Vinnie introduce his panel. And, by the way, we have a pretty select group up here. Vin.

Panel Discussion

PURCHASING AND SPECIFICATIONS OF WORK EQUIPMENT

Moderator: Vincent Terrill, Rail & Trk. Cnstlt., Terrill Track Consultants

Panelists: Roger Cross, Asst.Ch.Engr., Prod. & Plng., CSXT
John Blanchfield, Supt. of Fld. Equip., NS
Bob Scanlon, Mgr.Dir.Pur., SP
Bruce Bradshaw, VP Engineering, Pandrol Jackson

Mr. Terrill: Thank you very much, Darrell. I wish you would have said those nice things about me when I was at Speno trying to sell you a little of that service.

We have a distinguished panel here this morning. There is no question about it. You are going to hear a little bit more about them after I give you a few words. On my immediate left is the man who is going to be our first presenter, Roger Cross. Roger is the assistant chief engineer for CSX.

We have with us John Blanchfield. John is from the Norfolk Southern. He is the director of their work equipment group.

Next to him is Bob Scanlon. Bob is director of purchasing and materials for the Southern Pacific.

Beyond Bob Scanlon is Bruce Bradshaw. He is vice-president of engineering with Pandrol Jackson, Inc.

The Roadmasters have had a standing subject entitled "Work Equipment Purchasing; i.e. Specifications" for some time. Understanding that they were joining REMSA in what amounts to be the largest and most successful equipment show ever, the Roadmasters board decided to go for a panel that would discuss where the various groups, the users, the work equipment maintainers, the purchasing people, and the manufacturers' suppliers fit in. Where do they agree? Where do they disagree?

In an era where everyone is talking about cooperation, joint ventures, and pulling the industry wagons into a circle, we wanted to see how that might point to a much needed change in the way we gather, write, follow, and use equipment specifications. This panel got together twice, once in Chicago and once in Charlotte, to discuss this situation. This is a hard-working panel. We put some time into this presentation here and right now we want to thank Darrell Cantrell for the backing and the support that he gave us.

We have a vision that specifications can become more generic in design, universal in nature, will incorporate the maximum in safety and quality, will allow space for innovations for both the railroader and the manufacturer, be able to sustain competition, and allow the supplier a profit. We all agreed up front that the closeness between the supplier and the user maintainer is gone. The good old boys are out living on their buyouts or consulting or emceeding a panel show in Denver, Colorado.

Properly designed specs can bring back some of the confidence that was lost amongst mergers and buyouts. What role should purchasing play in this specification thing and how much leeway should they be given for a proper comparison of product? Should new equipment be held to standard performance specs that allow the manufacturer the freedom to use his own part specs and assume the risk of producing a performance promise of paying a warranty?

Right now there aren't two railroads that use equal specs for the same equipment.

Europe now uses the ISO9000 which comprises five sets of quality standards. If a North American supplier wants to do business in Europe, they had better learn how to comply.

Will the railroads in North America accept these standards on which to build specifications or will this just add another group of qualifiers to the boiling pot? This business of parts keeps coming into the picture. Some railroads specify parts, motors, and systems because of inventory, local supply, or simply from past practice. How does this affect the manufacturers' ability to comply or keep the equipment price competitive?

Keep your seats. I have four young men here with all the answers. Before I introduce them, again, let me set some rules. Write your questions down with the speaker's name and hold them until all our speakers have spoken. We will have a question and answer period following all four presentations. We want your questions and a lively discussion short of fisticuffs, but let all speak first.

Our first speaker will be the equipment user, Roger Cross, assistant chief engineer, production and planning for CSX Transportation. Roger and wife Karen reside in Jacksonville, Florida, with their four children.

Mr. Cross began his railroad career in 1971 on the former L&N Railroad in the track department. In 1978, he became a roadmaster. In 1982, he was assistant division engineer on the Atlanta Division and then senior assistant division engineer before becoming division engineer on the Baltimore division. In 1990, he assumed his current position.

Roger will discuss the part that the user plays in determining what specifications to request for safety and production. Roger Cross. (Applause)

A USER'S PERSPECTIVE ON EQUIPMENT SPECIFICATIONS

Mr. Cross: Thank you, Vin. CSXT is committed to being the safest railroad in the country. The primary responsibility of the CSXT engineering department is to serve our customers in the spirit of partnership by providing the safest and the best quality railroad in a cost-effective manner.

The equipment that we use plays a major role in accomplishing our goals. As railroads rebuild and design maintenance-of-way equipment, we must be mindful of the environment in which our operators and mechanics work. Our designs must deliver equipment that provide us a safer, an easier, and a better place to work. We must design equipment where the attitude of the operators and the mechanics will be one where they want to operate and maintain the equipment. We have found that the key to safety is attitude.

Our dedication and commitment to safety has enabled us to eliminate 529 injuries over the past five years. With continuous improvement we can and will achieve the ultimate goal of managing beyond zero. The continuing improvements and developments in roadway equipment will definitely play a great part in reaching this milestone.

The three key areas of equipment safety that we must focus on are: accessibility, visibility, and environmental.

Accessibility

Railroads and manufacturers must look to future designs that will provide for safer access for operators to mount and dismount equipment and for a safer access for mechanics

to maintain and repair equipment. Slip, trip and fall as well as pinch-point injuries can be eliminated as we improve accessibility.

Here is an example of a regulator remanufactured in our Bryant Park Shop at Richmond, Virginia. The frame has been extended four feet to provide for rear entry with platform and hand rails. This design eliminates the need for the operator climbing up, on, and around the wing to enter the cab.

The next slide shows another example of a redesigned regulator. Note the improved accessibility that enables the mechanic to safely maintain the broom assembly. This slide shows another location where the access has been improved to repair and replace hydraulic components.

Visibility

Better visibility for the operator is a necessity when it comes to a safer and more productive operation. We must strive to remove blind spots not only when traveling and working, but also for observing machine operations.

Here are two examples of improved cab design and placement that not only greatly improve visibility but also operator comfort.

Environmental

We must have a commitment to a better work environment for our employees and to the environmental impact of our operations and our surroundings. Let us use an adze as an example. As we all know by experience, the adzing of ties during rail gang operations is historically the most dangerous process in the industry.

Now with the introduction of the new equipment, the operator can remove his metal leggings, full-face protection, respirator, and coveralls and eliminate all potential hazards that previously existed to him in this operation. Now the operator works in a controlled environment that is dust free. This makes a safer, healthier and happier employee.

Quality and reliability

In the past, the railroads have demanded and received higher productivity in their new equipment. Today and in the future, we must focus on better quality and more reliable equipment components and repair parts. Without improvements in these areas, we will never be able to realize the productive design in our equipment.

Let us take a look at the downtime that has occurred on CSXT timbering teams in two months. These timbering teams average 600 hours per month in machine failures. I think it is important to note that most of our timbering equipment is 1989 or newer. Although some equipment failures do not fully stop the team's performance, these failures greatly impact its productivity. It must be remembered that the majority of our teams receive an average of 5.5 hours of crash time per day.

This chart depicts equipment failures in a typical month on an average tie team. It shows failures by major area. Hydraulic, electrical, and component failures are the three leading problem areas that account for 89 percent of the failures. Let's now focus on these areas.

Hydraulic

We all have the perception that hydraulic leaks are to be expected and are acceptable. I have heard many people make the statement that hydraulic equipment and fittings will always leak and there is nothing that we can do about it.

Hydraulic failures on large tie teams amount to approximately 33 per cent of our downtime. These are the most costly and common failures. Leaking fittings, blown seals and hoses are not unique to old equipment. They are also common to the new equipment used on the railroads. We must set and achieve the goal that all hydraulic equipment will be leak proof.

Electrical

Electrical reliability problems account for 16 per cent of our downtime. The time required to trace and locate failed electrical components and their cause are of major concern. We must update our existing electrical systems and use modern computerized technology in our new and rebuilt equipment. This will enhance the reliability and expedite the procedure for locating failures thereby reducing the time required to troubleshoot our equipment.

Components

Component quality and reliability problems account for the largest percentage, that is, 40 per cent of our downtime. The replacement cost of components is the largest expense when it comes to operating roadway equipment and it is still climbing. Both hydraulics and electrical problems contribute to some of the component failures.

Blown hoses lead to contaminated systems that lead to pump and valve failures. Numerous components fail due to design problems. The railroads' and manufacturers' personnel must work in partnership to identify these components and develop solutions to eliminate these failures.

Here is a chart that depicts the cost of repair parts used by our tie teams for the month of June and the year-to-date summary. Please note that this is only a fraction of the costs associated with these failures. Not shown are costs such as labor to repair, loss of productivity, and other hidden costs.

It is my opinion that the biggest savings are not to be found in productivity increases, but in increased reliability. Let's look at the two major areas; hydraulics and components.

One of the major hidden costs associated with hydraulic leaks is illustrated by a yearly expenditure of over \$1 million for hydraulic fluid. We are working together with manufacturers to overcome this problem. One solution is the use of O-ring face seal fittings originally designed for the aircraft industry to stop leaks and re-engineered manifolds to reduce independent valves and hoses. These design features are included in the adzer-cribber.

Additional reliability improvements can be found in improved hydraulic oil cooling-systems and improved seals and O-rings. When a component shows signs of weakness through repeated failures, the railroad and the manufacturer must work together to redesign the component to be reliable, thus reducing costs.

At our Bryant Park Shop, we are using this approach and incorporating redesigned components to replace numerous high failure components throughout our equipment rebuilding program. This has enabled CSXT to greatly reduce the repair costs on these pieces of equipment. One of the benefits of this cooperative effort is the ability to develop new equipment to reduce or replace labor-intensive tasks.

One example is the new tie plate machine. It is designed to eliminate the labor required to handle tie plates on rail teams by picking the plates up and automatically placing them on the tie to gage.

Another example is a machine designed to feed and productively install screw spikes in Pandrol plates.

In designing and specifying new or redesigned roadway equipment, we must always remember our goals of safety, quality, reliability, and to be cost effective. Thank you. (Applause)

Mr. Terrill: Thank you very much, Roger.

Our next speaker has the maintainer responsibilities. He is John Blanchfield who would like to have the role of the Maytag repairman, but can't get the Norfolk Southern to take Maytag over yet. They did, however, get John a new reel of barbed wire to repair his machines.

John attended the University of Maryland in mechanical engineering and King's College for business management. He met and married the beautiful Jorie Ann McDonald of

Annapolis, Maryland. Jorie Ann is a domestic engineer, accountant, nurse, and psychologist for the Blanchfield family in Charlotte.

The US Army gave John an all-expense paid trip to Viet Nam where he was awarded a bronze star for bravery. John is a member of the Roadmasters Association and AREA Committee 27. He began his railroad career with Southern Railway Company 23 years ago in Washington, DC, in the engineering and research department's freight car design. After two years, he was transferred to Charlotte to the tools and methods engineering section which, eight years later, became the maintenance-of-way department new design engineering section. Two years later, John became manager of his section and three years after that, he was named superintendent of field equipment, a position he presently holds. John Blanchfield. (Applause)

A MAINTAINER'S PERSPECTIVE ON EQUIPMENT SPECIFICATIONS

Mr. Blanchfield: Thank you, Vin.

Good morning. I would like to thank everyone for allowing me this opportunity to present a brief overview of Norfolk Southern's specifications for roadway equipment. During this portion of the briefing, I am not only going to cover Norfolk Southern's specifications for roadway equipment, but I am also going to cover some of the originating factors which go into the formulation of our equipment machinery.

As seen on this slide, we at Norfolk Southern solicit input from all phases of our operation from our operators, repairmen, supervisors, and engineering section. We are of the belief that this type of collective data enables Norfolk Southern to submit to bidders the most comprehensive specifications available.

First, from the operators who play a very important role in our specifying of equipment, we ask their input into safety. An example of this is shown here. The addition of this hand rail and step arrangement on our tampers was suggested by our operators. Their input into ergonomics has resulted in a comfortable, easily operated piece of equipment with an environment from which they can be the most efficient.

In the area of preventive maintenance, operators will be the first to explain that the easier an item can be serviced, the more likely this item will be serviced. The operator's recommendations always prove beneficial in providing safe, efficient means of servicing equipment.

Operational improvements are also vital to us in formulating our specifications. Who would know better an area for improved operational efficiency than the person who operates the piece of equipment on a daily basis. Our equipment repairmen serve an equally important role in the process of specifying roadway equipment. We seek similar information in safety, both in operation and maintenance or repair.

We inquire into the equipment quality and improved ideas to improve the quality. We solicit ways to improve major maintenance items. We ask what items are difficult to repair or cause the most problems and what can be done to change and help their situation. We ask what can be changed to make the machines more efficient..

Our repairmen have proven to be invaluable in their contributions in the specification process. We rely heavily on supervision for their contributions in safety and what they believe can be done to improve the safe operation of machinery. We inquire into what changes to our equipment are needed to improve quality such as accurate lining and rail

laying or better methods for bundling ties.

Additionally, we will solicit production requirements for future operations; production requirements which are attainable and, when applied, produce significant reductions in the cost of operations.

Our engineering design and roadway maintenance equipment sections provide similar contributions in safety and quality as the aforementioned areas. However, these sections also provide engineering support and design of prototypical machinery and compatibility of a system and components.

Norfolk Southern has invested in a state of the art Integraph 3-D solid modeling computer-aided design system. This system is used extensively for the prototypical design and assurance of compatibility between machines. Norfolk Southern's specifications can be best described as a collection of information gathered on a continual basis providing Norfolk Southern with the most reliable expertise on machinery and equipment available today.

During the second portion of this briefing, I am going to address Norfolk Southern's specifications and what comprises a typical specification. Norfolk Southern's specifications can best be categorized in four major areas: A description section, performance section, general requirement section, and detail section.

The description section describes the equipment in general, identifiable terms as type, model, et cetera. An example of this is our specifications for a combination switch production tamper; a 16-tool combination switch tamper; four-wheel drive, hydraulically motor driven through four speed Funk transmission, heavy duty chain drive to axle; combination ball and rail base clamp; Delta surfacing system with inclinometer; and computer line/light system.

Our performance section outlines requirements of cycle times, travel speeds, and breaking requirements. An example of one such requirement may be travel speeds whereas we require certain pieces of equipment to travel at 25 miles per hour on a two per cent ascending grade.

The next major area is the general specifications section. This section contains Norfolk Southern's requirements in areas which are general to numerous machines such as safety, where adherence to all OSHA, FRA and NIOSH standards must be met, and hydraulics where the National Fluid Power Association standards must be met. Electrical standards must meet UL, FM, and CSA standards where applicable.

We would address bearings and the requirements to conform to the American Federation of Bearing Manufacturers Association standards. Noise requirements are addressed and must be no higher than 85 decibels low "A" Scale at the operator's ear.

Paint requirements are addressed as to type, manufacturer, and applied thickness. The mechanical portion entails minimal standards on frames, transmissions, and drive train components. Fuel capacities are called out in terms of minimal allowable time between refueling. We also require six copies of all manuals for each piece of equipment. Delivery terms are addressed here as well as warranties as they apply to individual parts or the entire piece of equipment.

The third section contained in our specifications is our detail section. This section addresses items unique to each machine or piece of roadway equipment such as the operator's enclosure, working and travel lights, engine arrangements and other numerous specialty items. Examples of how these items may be specified in this section are as follows.

Take, for instance, the operator's enclosure. We may address control locations, window glass, door locks, seat models, heater, air-conditioned and/or pressurized types, and the operator's location, which we feel is the best ergonomic arrangement for operating the machines.

We provide the bidders with detailed instructions as to combination of working and travel illumination. We will address engine arrangements. We will instruct bidders on whether skid-mounted engines are required and what specific types are to be included such as engine crankcase drains and soundproofing. This is also the area in our specifications where

specialty items are addressed. These specialty items can range from unique drive arrangements to electrical enclosure arrangements to special hydraulic cylinders or filters or maybe a certain type of seat for our operators.

We at Norfolk Southern consider our specifications the combination of a progressive team effort of all of our combined resources to ensure our obtaining the most safe, efficient and quality piece of equipment available on the market today. Thank you. (Applause)

Mr. Terrill: Thank you very much, John. Most railroaders look at the purchaser as a sort of a mystery man. The railroader blames him because he doesn't know anything about the equipment. The supplier blames him for being a know-it-all.

Our mystery man is no stranger to purchasing policies or to the Southern Pacific Transportation Company.

Robert J. Scanlon is managing director in the purchasing and materials department at Southern Pacific. He joined Southern Pacific in 1990 after 16 and a half years with Caterpillar. At Caterpillar he served in a variety of purchasing and quality positions in the earth moving, engine, and lift truck divisions as well as at corporate headquarters. At Southern Pacific, Bob served as director quality and reliability engineering for two years prior to moving to the purchasing and materials department. In that capacity, he contributed to the design and implementation of Southern Pacific's quality improvement process.

He developed the company's three-day statistical process control training course and introduced weibull analysis as a tool for improving product reliability.

Robert J. Scanlon holds a Bachelors degree in metallurgical engineering from the University of Missouri at Rolla and is a ASQC certified quality and reliability engineer. Bob and his wife Janet have three girls. Bob Scanlon. (Applause)

A PURCHASER'S PERSPECTIVE ON EQUIPMENT SPECIFICATIONS

Mr. Scanlon: I would like to begin by first thanking Jim Young from the Southern Pacific Engineering Department for an opportunity to join this panel today and also Vin Terrill for his kind introduction and the guidance he provided in preparing for this presentation.

I appreciate the opportunity to address this subject which is purchasing and work equipment specifications. It is obviously an area that has generated a lot of interest and I'd like to share some of the perspectives from a purchasing point of view that are embedded in this subject.

The agenda by which I would like to frame my remarks today is first I would like to talk about purchasing's role in the organization, the role of specifications in the procurement process, what makes a good specification from a purchasing point of view, where we are today with specs, where I believe we are headed, and then a few summary remarks.

First of all, purchasing's role is to provide the internal customer, in this case the engineering department, with a reliable source of goods and services which meet their requirements, support the company's mission for reliable transportation service, and help the company achieve continuous improvement in safety, quality, productivity, and competitive position. I think the purchasing department has a strategic role to play in accomplishing the company's mission.

Another aspect of its role is to manage the interface relationship between suppliers and the internal customer, again, engineering in this case. We are charged with maximizing corporate performance through asset management which in many cases involves the on-going

effort to inventory but, of course, in this forum we are really talking about helping to improve the utilization of work equipment. Also overall, to negotiate the greatest value for the company during the procurement process.

I would like to spend a few seconds here on some of the strategies that the purchasing department is using to achieve its mission.

One of the things we are beginning to develop within our organization is the use of commodity teams which are cross-functional groups that study critical commodities. One of the strategies is to reduce the supplier base to only that number of suppliers which we feel is necessary to support the company.

In some cases that might go so far as to mean single sourcing if it makes sense, but that isn't a hard and fast objective. The point is just that as we evaluate the commodity, that's one of the issues which we look at. How many suppliers do we really need? Is there an opportunity to reduce the supplier base? Having more suppliers than necessary is an additional cost burden to the company. Another critical strategy is quality improvement. We have heard a lot about that in this conference starting with Stan McLaughlin's remarks yesterday. Vin alluded to the fact that Southern Pacific generated or initiated a quality improvement process late in 1990, and launched it in January, 1991. From a purchasing perspective, what that means is that we are beginning to evaluate our suppliers in the four areas of quality, life cycle cost reduction, delivery, and service. Another strategy where it makes sense is to develop partnerships and move to long-term contract arrangements with our major critical suppliers.

Going back to basics a little bit. What is a specification? Well, boiled down to its simplest terms, I think it is a description generally in technical terms of the internal customer's requirements to perform a particular function. I think Stan McLaughlin's remarks yesterday were significant. He said it is very difficult to ask a supplier to provide or meet your needs if you haven't adequately defined your needs. I think that ultimately the challenge in specifications is to call out specifically what the internal customer requires in the way of work equipment.

Now a brief look at the procurement process and the specification process as a subset of that. In general, engineering has the responsibility for developing what their needs are and embedding that in the document we call the specification. That is given to purchasing who uses the spec to communicate that requirement to the supplier community and to identify and evaluate viable sources for the equipment.

Of course the supplier again uses the spec to determine whether he has equipment that meets the needs of the customer and to frame the bid proposal. But, again, it is important that the specification as it is developed captures the entire and complete need of the internal customer.

So why are specifications important? From a purchasing perspective, they are extremely important because they are the input into the purchasing process as far as the purchaser is concerned and purchasing's ability to fulfill its role is directly related to the quality of the specification provided.

Characteristics of a good specification? Again, it should accurately reflect the customer needs, in this case, the engineering department. It needs to be achievable. It isn't productive to put out a specification that no supplier in the industry can meet. In general, purchasing would prefer a specification that is generic enough to allow for competitive proposals.

Where are we today? Well, a review of our specs today would say that there is more work to be done to improve consistency. The specs today tend in many cases to be model and component specific and in some cases I think that's necessary. But I feel in other cases suppliers might view that as being restrictive to their ability to provide alternate designs to meet the needs that engineering requires. Also, I think there is room for improvement in focusing on what is really important in work equipment.

So let's talk about that. What really is important in work equipment? If you take the four

areas that we try to evaluate suppliers on, quality, life cycle cost reduction, delivery, and service, those items translated to work equipment would generate a list like this:

Performance of the equipment. How well does it drive the spike or tamp the ballast? What is the productivity that the machine can support? Can it put in 1,500 ties a day if that's what the engineering goal is? What is its availability? What is its up time?

The engineering department at Southern Pacific has recently put in a service center in Denver to gather information throughout the system on how much work equipment is down and we are using that information to identify improvement opportunities. Availability, as I'm sure you are aware, is again driven by reliability and maintainability or the mean time to repair equipment.

As Roger Cross and John Blanchfield mentioned in their remarks, reliability of equipment is emerging as a much more significant issue and therefore needs to be reflected in specifications. Roger alluded in his remarks to topics like ergonomics and safety which continue to be important and emerge as vital issues.

Again, the question is, do the specifications reflect those requirements?

Another issue obviously is technical support and that is support during and after the sale. This involves things like training of operators.

So I submit to you that it is very important that specifications address these issues. As we look at where we are today, we need to evolve specifications to be much more direct and provide specific requirements in all of these areas.

Just a few comments on the dynamics that affect specifications. I think what we have been seeing over time is an increased focus on what is the function that this equipment needs to perform as well as what is the goal of the engineering department in terms of their production rates and the job that they need to do on the track structures.

I think there is obviously an increased reliance of the supplier base as the technical expert. I am relatively new in the rail industry but the dynamics that seem to have been in place for quite some time is the downsizing of railroads and the inevitable shrinking of the technical base that used to reside within the railroads.

That base now for the most part has shifted to the supplier community and I think in some cases we need to provide suppliers with more latitude. Give them the overall requirements and then give them the latitude to meet the requirements in the way that they feel best does that through their product design.

The last item is a move to system solutions. The logic here is the same as the point Dennis Waller made this morning in terms of what he called turnkey technology. This simply means work equipment can't be looked at as a single piece of equipment and it can't be looked at in an isolated way. It needs to be considered as part of the overall system that is working out there on the track.

So to sum up, specifications from a purchasing perspective are a critical tool in the procurement of work equipment. The ability of purchasing to do its job is directly related to the quality of the specifications. In my view, specifications need to change and improve in order to address what is really important, with special emphasis on things like reliability and availability of equipment, up time.

Ultimately what is really important is that purchasing, engineering, and suppliers involve each other early in this process, and improve the dialogue and the communication between the groups in order to provide the maximum value to all parties. Thank you very much. (Applause)

Mr. Terrill: Thank you very much, Bob. I want to particularly thank Robert as he and I were working coast to coast, he in San Francisco and I in Boston. We didn't know each other and he came through with an excellent presentation regardless of what I told him about you guys. (Laughter)

Lastly, we have the poor, oppressed manufacturer/supplier. If the specs are too restric-

tive, how can he innovate and if they are too general, does he know how to stay price competitive? Fortunately, we were able to get one of the best in the business, Bruce Bradshaw.

Bruce W. Bradshaw is a second generation railroader. His dad started in 1936 with the Electric Tamper and Equipment Company and worked for 32 years ending in 1968 with Jackson. Bruce has B.S. and M.S. degrees from the University of Michigan. He is a registered professional engineer and a member of the National Society of Professional Engineers, an associate member of the Roadmasters Association, AREA, and a member of Committee 2. He has spent 28 years in Pandrol Jackson, formerly Jackson Jordan, as project engineer for reference systems, control systems, tampers, track surfacing/lining systems, and has been vice-president of engineering since 1977.

Bruce and his wife Karen have three children.

Bruce, Frank Ross says that your equipment can run on water. What we want to hear today is if you have specified for that equipment to run on water. Bruce Bradshaw. (Applause)

A SUPPLIER'S PERSPECTIVE ON EQUIPMENT SPECIFICATIONS

Mr. Bradshaw: Thank you, Vin, for that kind introduction and thank you for allowing me to be here today to give a supplier's perspective on work equipment specifications.

As Vin said, I have been around the industry for quite a few years now and I have lived through a great amount of change. I would like to address this morning one of these areas of changes and that is the way that the industry is treating work equipment specifications. Many of us might get uncomfortable with change from time to time, but I believe it's a part of life and if we approach it positively, we can all benefit.

I would like to start this morning with a question. Who benefits from an improved specification process? We have already heard quite a bit about that and I think it will be clear. Equipment specifications have an effect on several groups of people both on the railroad side and on the supplier side. I'd like to discuss problems that we have with specifications as I see them and I will briefly touch on how they affect the people shown on the slide from the chief engineer, purchasing, equipment operators, roadmasters, and also several people in the suppliers' organization.

To begin with, just how detailed should specifications be? In practice, we see for similar machines some specifications that are very detailed and many pages long and yet we have other customers who either have very brief specifications or none at all. Why do we have these differences? What problems does this create?

In the past, supply companies tended to be smaller and there tended to be more of them. Most of my career has been with what I describe as a small supply company. In this environment, our engineers are expected to wear several hats. Sometimes they might be a shop foreman and sometimes a designer and occasionally maybe even a purchasing agent. Our engineers would work closely with a few key suppliers who in some cases participated significantly in the design process. Components were generally selected based on confidence between those two.

Today as part of a larger supply company, this same engineer is expected to provide our purchasing group with written specifications for machine components and purchasing in turn will select the best vendor. The specifications must also be supplied to a design review group

and to our quality people.

More people are involved in the process today and this has not been easy, especially for some of our older engineers, to accept. Yet in today's environment of increased competition and total quality objectives, we realize that these important processes are vital to our future.

Similarly, on the railroad side of the picture in the past, contact between smaller railroads and a larger group of suppliers was less formal than it is today. Personal contact between the customer and supplier created a different atmosphere with a level of confidence that existed between the parties and complimented a simpler specification document.

It is different today. Personal contact is reduced because fewer people are available on both the railroad side and the supplier side. This makes it necessary to put things on paper that were formerly just left as a word-of-mouth understanding between the parties.

Work equipment today is also much more complex. Machines we produce today have complex hydraulic systems and electronic systems and also they may have several computers. As equipment has become more complex, a simple specification will no longer suffice. More detail is required and this will benefit both the railroad and the supplier.

In preparation for this talk, I surveyed several departments in our company about equipment specifications. Some comments from our order entry and our quality people were as follows: Why aren't specifications always furnished with the request to quote? Why do some specifications change so often? Why do some requests to quote come in with no specifications and also sometimes with a very short deadline to quote and deliver the equipment? Another comment was, why do specifications have so many vendor parts specified?

Occasionally we have customers who specify specific vendor parts rather than considering the performance that is expected. This really takes away the suppliers' responsibility to design the appropriate component to do the job reliably and cost effectively. What is sometimes even more disturbing about that practice is how often these vendor parts are changed in the specification. This creates design problems particularly when parts such as hydraulic components may have different mounting arrangements from one vendor to the next and cannot simply be changed without affecting the rest of the design.

Somehow we need to find a middle road with the supplier maintaining his design responsibility and the railroads spelling out exactly the performance that is required. In general, a focus on performance rather than specific parts will benefit everyone.

Probably by now many of you have heard about ISO9000. In case you haven't, I would just like to say a few words about the subject because it has such a direct bearing on the specifications issue. ISO9000 is a group of five sets of quality standards set forth by the International Standards Organization in Geneva, Switzerland. The standard is an outline of the procedures that a company must have in place in order to assure that a quality product is delivered to its customer.

Many companies in North America, including railroads and supply companies, are working towards compliance with ISO9000. As an example, section 4.3 of the ISO standard requires that a supplier ensure that his product requirements are adequately defined and documented. This established the need for a well-defined specification. Section 4.4 of the standard requires that the supplier establish and maintain procedures to control and verify that his product's design and performance meet the customer's specs.

The ISO9000 standard does not contain any revolutionary ideas relating to specifications. However, the standard does contain some simple, common sense systems that have the potential to reduce some of the problems that we have with the specifications in the industry today. The affect of the standard is that we as suppliers must make a commitment to meet our specifications, but that also the users of the equipment must furnish a well-written comprehensive specification.

As railroads and the supply industry move towards implementation of these new standards, we can all expect to be more involved in the specification process.

Going back to our original question. Who benefits from an improved specifications process? The answer to that is that we all do. Let's now look briefly at how this happens.

First, we could say that the roadmaster or the user is the primary beneficiary of improved equipment that has been dictated by specifications. For example, operator safety has been enhanced recently by equipment such as lumbar-supportive seats, seat belts, sound proof air-conditioned cabs, tinted window glass, adjustable control stands and automated controls for operation and set up.

Safety in and above the machinery has been enhanced by such things as horn buttons at the corners of the machines, controls over buggy wheels, and steps to allow reaching areas of the machine for attention. There is no doubt that specifications addressing these issues benefit the roadmasters and their people. After all, if workers are made more comfortable in their jobs, they are both safer and more productive.

Benefits of the chief engineer are seen primarily financially at the bottom line. Specifications that aid in safety or productivity cause the job to get done quickly and efficiently without the expense of personal injuries. Specifications can also be a useful vehicle to let the supplier know what the chief engineer wants, particularly in terms of improved performance.

Thirdly, specifications benefit the purchasing department and should be used to determine that you are getting what you paid for. This implies a sufficient level of detail without which some decisions concerning important issues may be left to the purchasing agent or the supplier who, in turn, are really not the users of the equipment. Properly, purchasing should be the middle man to find out what the user needs and pass that need onto a supplier.

Written specifications are the only way that this can effectively be accomplished. From what is typical today, performance specifications usually help to determine what machine in the product line should be quoted but do little to push the limits. Specifications for performance, in some cases, may be watered down so as not to exclude any potential supplier. While this is understandable, I would prefer a specification that pushes technology forward. I think this is better for our industry.

In conclusion, specifications will take on an increasing level of importance with the advent of quality standards such as ISO9000. This will require more cooperation between the supplier and the railroad. Also, specifications should be the avenue toward product improvement and performance of the equipment.

Finally, working with specifications requires effort both on the part of the supplier and the railroad. The rewards for this effort, though, come in the form of increased confidence between the railroad and the supply company and in the delivery of safe, reliable, and productive equipment. Thank you. (Applause)

Mr. Terrill: Thank you very much, Bruce. I know that many of you out there have had the experience of speaking. I know that you know how much time it takes and how much effort, extra effort I might add, because this is above and beyond your regular duties, to put together some superlative slides like we have just seen and the talk that goes around them and still keep it within a certain time period.

I would like to have a special round of applause for our four panelists who were able to do that so well. (Applause)

Once more, I'd like to thank Darrell Cantrell for his support in helping us put together this panel. Now we are going to turn this over to you. We know that your voices are tired from the football game last night. We have given you a rest and now we are going to ask if there are any questions for our four panelists. I know that you have some.

Member: Thank you, Vinnie. I am Hubert Meek, retired general roadmaster for the Rio Grande. I would like to ask Mr. Cross if he knows the reason for his tie gang number 7 to be head and shoulders above all the others in downtime. Is it preventive maintenance, new machines or perhaps they didn't report all their downtime?

Mr. Cross: I need to look at the chart. We have six major tie gangs which are 34-man gangs. Then we have T7 through T10 which are small gangs. We do have, of course, the best equipment on the first six gangs and we have our older equipment on the small yard tie gangs. T7 is one of the small yard tie gangs.

Member: My name is Gary Thompson, manager of engineering maintenance at St. Louis for UP. Mr. Scanlon, what is your company's emphasis on warranty specifications and what, in your view, is the increasing importance of that warranty provision for supplier contracts in the future?

Mr. Scanlon: Well, as a purchasing department, our emphasis on warranties is that we would like to negotiate the longest term warranty we can get for the equipment. I think we have been successful in recent years in extending warranties beyond one year to two and even three years on certain types of equipment. In my view, a warranty somewhat reflects a manufacturer's confidence in the ability of the equipment to perform and not fail during the warranty period.

In every case, we would like to negotiate as long a warranty as possible. Ultimately, we would not like to ever file a claim during the warranty period which means that nothing has failed, but I think a warranty initially will assure that when a product does fail, first of all, feedback is immediate to the supplier so they are aware of what their product problems are. It's a way of addressing some leverage with the supplier because ultimately, if it is costing him something, there is an incentive there to improve the reliability of the equipment. That's really the motivation.

Even if something is covered under warranty, the fact that the part is replaced isn't the biggest cost to the railroad. The cost to the railroad is the downtime and the problems caused the work gangs out on the track structure. That is what we ultimately want to avoid.

Mr. Terrill: Thank you very much.

Member: My name is Domenic Bua and I am from Gordon Bua and Read, Inc. My question is addressed to Mr. Blanchfield and it really could be addressed to Mr. Scanlon or Mr. Cross also. When your equipment is being rebuilt or upgraded by your own shops, who writes your rebuild specifications and how are they monitored for compliance? Also, are there any performance specs that you use?

Mr. Blanchfield: In our shops, we work closely in liaison with the shops which are at the same location as the field forces. What we do is go over the requirements for the machinery with the shop manager. He is aware of our specifications and what we require and how we monitor it. We monitor it during the actual rebuild or upgrade and then we will bring in an operator from the field, preferably the operator who will receive the machine, to run the machine and check it out, plus one of our work equipment supervisors to check the machine out after it is repaired. This gives us an assurance that when the machine hits the line on road, it is ready to run at its requirement.

Mr. Terrill: Thank you, John.

Member: I am Bill Marshall, engineering work equipment, CP Rail. The question for Bruce is we have heard the terms reliability and maintainability brought up by quite a few of the speakers today. At CP, we have had mean time between failure and mean time to repair targets in our specifications for the last five years. In general, it has not had a unanimous response from the supply industry. There has been an ignorance or a failure to respond to these requirements. I guess the question for you, is there a realization in the supply industry that reliability and maintainability are integral to machine design and if so, how do you intend to meet those requirements?

Mr. Bradshaw: We currently have two contracts that we are working with for supplying equipment to our customers that have availability requirements in them. They are generally written in terms of what percentage of time is that machine going to be available to go to work and when is it time to go to work?

I expect that in our industry in North America we will be seeing more emphasis on availability requirements. Also from the suppliers' perspective if you are talking about availability, you also have to talk about maintenance and how the machine is maintained. As suppliers, we are going to be very interested and probably have to do a better job in writing operators' manuals to make sure that the maintenance on the equipment is done properly. So the availability will be there. It also does weigh heavily on the selection of parts that go into the design of the machine as we see an increasing emphasis on reliability and availability.

Mr. Terrill: Thank you, Bruce. I know there are a lot of other questions but we are out of time and I'm sorry for that. One more round of applause please for our panelists. (Applause) And a round of applause for you. (Applause)

Mr. Cantrell: Thank you very much, Vin and panel, for such a good quality presentation. At this time I'd like to turn the podium over to Paul Saletnik.

President Saletnik: The latest registration totals as of 9:30 this morning counting the 1,600 preregistered shows conference registration at 2,191. With the spouses, that's a grand total of 2,700, which is outstanding.

With that, I hereby close this morning's joint session. The Roadmasters will reconvene in ten minutes in this same room. The B&B will reconvene in ten minutes in C111 and 112 which is immediately behind the registration desk on the other side of the building. Thank you, very much. This session is now adjourned.

B&B SESSION

TUESDAY MORNING – 10:00 A.M.



Paul Saletnik

President Saletnik: Welcome, gentlemen. I'm not going to take a great deal of time to have another president's address here. As I stated earlier this morning, I am very proud to be president of the B&B Association and also proud of our industry. From the time I started in the railroad industry, there has always been a lot of doom and gloom around so it is sure nice to be looking to the future with great optimism.

It is customary to recognize the past presidents who are attending our conference. As I announce your name, would you please stand up and face the audience.

Mr. W.H. Hoffman, retired assistant vice-president and chief engineer, C&NW, president 1957-1958; Wally Sturm, retired senior project engineer-buildings, Elgin, Joliet and Eastern Railway, president 1978-1979; Jim Budzileni, retired senior structural engineer, Illinois Central, president 1983-1984; Jim Williams, retired supervisor, B&B, Elgin, Joliet and Eastern Railway, president 1984-1985; John Kapp, system engineer, Conrail, president 1986-1987; Don Lewis, bridge construction engineer, Illinois Central, president 1987-1988; Ray Tallent, process engineer track, Norfolk Southern, president 1988-1989; John Horney, senior director of construction, Amtrak, president 1990-1991; and Mark Walbrun, director of capital projects, Amtrak, Chicago Union Station, president 1991-1992.

Let's give these gentlemen a round of applause. (Applause)

I would also like to acknowledge the presence of our longest active member, Mr. Fred Day. (Applause)

As I mentioned this morning, I am proud of the seminars that this Association has

instituted. We owe a great debt of gratitude to the people who are involved with those seminars and, in particular, John Horney and Tom Parker because it was their brainstorm that got the whole ball rolling. I would like to have all those involved with the seminars to come up front. We have a little presentation as a token of our appreciation. Since they invested a great deal of extra time above and beyond the call of duty, we have this clock as a token of our appreciation which says, "B&B Seminar Instructor."

The first clock goes to John Horney. Thank you very much for your service. Tom Parker, I believe is not with us here. We have Don McCammon and Don Sorgenfrei. Thank you both very much. Joe Lileikis, thank you very much.

Those are the gentlemen who were involved. John Horney and Tom Parker began the contractor seminar. Don Sorgenfrei, Don McCammon, and Joe Lileikis started the bridge inspection seminar.

Continuing on as our chairman of our training is Bill Nelson and additional instructor, Dave Franz. (Applause)

I would now like to call on Mark Walbrun to present the nomination of officers.

NOMINATION OF OFFICERS

Mr. Walbrun: The following persons have been recommended by the nominating committee for the 1993-1994 slate of officers.

For president, Don Steele, manager of bridge construction, Union Pacific Railroad, Omaha, Nebraska. For senior vice president, John Van Huis, chief engineer structures and procedures, Wisconsin Central, Fond du Lac, Wisconsin. For junior vice presidents, Mike Bradley, project engineer, Conrail, Columbus, Ohio; and Joe Lileikis, manager of bridge maintenance, Union Pacific Railroad, Salt Lake City, Utah. For treasurer, Don Lewis, bridge construction engineer, Illinois Central, Chicago.

For Directors with terms expiring in 1994: Bob Carter, general B&B supervisor, Burlington Northern, Springfield, Missouri; Carl Young, project engineer, Conrail, Carleton, Michigan; Dave Franz, bridge engineer, Kansas City Southern, Kansas City, Missouri.

For Directors with terms expiring in 1995: Lee Hostler, structural engineer, Santa Fe, Albuquerque, New Mexico; Jimmy Neece, B&B supervisor, CSX, Helena, Alabama, Ron Kaye, Joliet, Illinois.

For Directors with terms expiring in 1996: Mark Johnson, director of bridge engineering, Burlington Northern, Overland Park, Kansas; Tim Rich, engineer B&B Conrail, Etters, Pennsylvania; and Dale Bartholomew, senior manager railroad facilities, Sverdrup Corporation, Kirkland, Washington.

I will now turn it over to our president.

President Saletnik: We have heard the slate of nominees recommended by the nominating committee. If there are no other nominees from the floor, I will accept a motion that the slate submitted by the nominating committee to be elected. Do we have a motion?

Member: Mr. President, I so move.

President Saletnik: Second?

Member: Second. (in unison)

President Saletnik: All in favor?

Member: Aye. (in unison)

President Saletnik: Opposed? The motion is carried and I hereby declare these officers duly elected.

We will continue now with the business session of our meeting. Pat, would you give us the secretary's report.

BUSINESS SESSION

Secretary's Report September 1, 1992, Through August 31, 1993

Total members, September 1, 1992.....	791
New members since September 1.....	75
Members reinstated.....	<u>1</u>
	867
Less: Deceased – Active	1
Associate.....	1
Life.....	8
Dropped – Active.....	28
Associate.....	19
Life.....	<u>4</u>
	<u>61</u>
Total members, August 31, 1993.....	<u>806</u>

President Saletnik: Thank you, Pat. I would now like to call Don Lewis to give the treasurer's report.

TREASURER'S REPORT September 1, 1992, Through August 31, 1993

Checking account balance, September 1, 1992 \$ 7,113

RECEIPTS

Dues.....	\$17,610
Advertising – 1991.....	4,550
1992.....	750
1991 Proceedings.....	211
1992 conference (net).....	1,551
Bridge inspection seminars	24,100
Interest on checking account.....	278
Miscellaneous	<u>395</u>
	<u>49,445</u>
	<u>56,558</u>

DISBURSEMENTS

Salaries	\$11,844	
Payroll taxes	938	
Employee savings	355	
Office rent, utilities & insurance	2,339	
Office supplies	511	
Equipment purchase, rent & repair	1,627	
Stationery & printing	2,739	
Postage	2,630	
1992 conference	845	
1993 conference	160	
1992 proceedings	1,459	
Bridge inspection seminars	17,570	
RT&S subscription for members.	1,512	
Executive Committee meetings	568	
Temporary office help & consultants	928	
Miscellaneous.....	<u>133</u>	<u>46,158</u>
Checking account balance		
August 31, 1993.....		\$10,400
Funds on deposit		
Advance Bank, Homewood, IL.....		<u>33,428</u>
Total funds, August 31, 1993.....		<u>\$43,828</u>

President Saletnik: Thank you, Don. I would like to call Wally Sturm to give the Auditing Committee report.

AUDIT COMMITTEE REPORT

To: Members of the American Railway Bridge and Building Association.

We, the undersigned have examined the books of the Secretary and the report of the Treasurer for the period September 1, 1992, through August 31, 1993, and have found them to be correct as of August 31, 1993.

Respectfully submitted,

J.R. Williams, Chairman

W.C. Sturm

J. Budzileni

President Saletnik: Thank you, Wally. Would you now give the necrology report.

NECROLOGY REPORT

To the President and members of the American Railway Bridge and Building Association:

It is with grief and regret that we report the known loss of ten members through death during the past year. It is possible that other members have passed away during the year of whom we have no information. If you know of anyone, please report their names to the secretary. The following have been reported since our last conference in September of 1992:

F.A. Baker
Gen. Bridge Insp. (Ret)
SP Transportation Co.
Joined 9-18-55; Died 8-19-92

Stephen E. Kesner
Supvr. of Training B&B
CSX Transportation
Joined 11-1-89; Died 11-8-92

C.W. Bartley
B&B Supvr. (Ret)
BN RR
Joined 9-4-66; Died 6-25-93

T.D. Saunders
Dir. Plng. & Research (Ret)
Ontario & Northland RY
Joined 7-1-30; Died 11-23-92

C.M. Burpee
Editor (Ret)
Wood Preserving News
Joined 1-1-30; Died 11-29-91

W.L. Termunde
Engr M/W (Ret)
Belt Railway of Chicago
Joined 6-16-56; Died 9-13-87

James W. Davidson
Asst.Chf.Engr.Dsgn/Strs (Ret)
BN RR
Joined 8-26-57; Died 2-21-93

Tom Triplett
Vice-president
Shugart Mfg. Inc.
Joined 9-17-85; Died 11-30-92

G.R. Frederick
Supt. Production (Ret)
CN RY
Joined 9-26-67; Died 7-30-92

Robert H. Walsh
General Sales Mgr. (Ret)
Holland Co.
Joined 3-22-73; Died 10-30-90

Miles Burpee was elected director of the Association in 1934 and advanced to vice president the following year, serving until 1937. He also served as president of the Association in 1938. He was our longest tenured member until the time of his death and he was the oldest living past president of the Association.

Jim Davidson served as a director of the Association on several occasions. He was elected to a term in 1972 and served through 1975. He also filled unexpired terms in 1980 and from 1982 to 1984.

I would like to ask for a moment of silence in honor of our deceased members. Thank you.

Respectfully submitted,

Wally Sturm
Chairman

President Saletnik: Thank you, Wally. Our next order of business is to review the proposed constitution change and vote on the proposed change. I would first like to review three primary reasons why this change is being considered. The first is the elimination of class distinction when it comes to providing input for problem solving and planning as exemplified by the creation of a quality team approach for the common laborer to be serving on a team with high ranking engineering department officials.

Second, the creation of shortline railroads where the bare-boned staffing and multi-discipline, multi-functional workforce performs a myriad of duties.

Three, the ever-decreasing size of the overall engineering department workforce and the resulting ever-increasing size of the supervisors' territory which necessitates local field employees take on greater responsibility.

The proposed change in the constitution is to delete the phrase, "Or individuals who are subject to collective bargaining," from the exception wording under the requirements for classification as full member as opposed to an associate member.

In 1990, the B&B Association voted to take out the description of a member as a person above the rank of the gang foreman and added the qualification phrase we now propose to eliminate. The concept is being taken one step further. If a railroad employee is willing and able to participate, why shouldn't that person have full membership privileges?

Most importantly, by maintaining a distinction of classifications among fellow railroad employees, we send the message that we may not value their opinion as highly as an officer. By sending such a message, we may be inhibiting employees' willingness to share ideas.

By approving this change, the B&B Association will be officially acknowledging the fact that a person's rank has absolutely nothing to do with the contribution and quality of wisdom that the individual is capable of sharing. This fact can never be denied when dealing with sincere and conscientious employees. By approving this change and thereby broadening the base from which we draw our knowledge, the B&B Association will set an example for the rest of the industry.

Do I have a motion to vote on that change?

Member: So moved.

President Saletnik: Second?

Member: Second.

President Saletnik: All those in favor?

Member: Aye. (in unison)

President Saletnik: Opposed? The constitution is hereby changed. Thank you very much.

I now turn the podium over to Mike Bradley who will introduce our first special subject.

Mr. Bradley: Thank you, Paul. Our first committee report will be presented by Preston Sargent, chairman of Special Subject No. 1.

Preston has a Bachelor of Science degree in construction engineering from the University of Nebraska and has been with the Union Pacific for 24 years. His current position is manager of mechanical systems design. I give you Preston Sargent.

Standing Subject No. 1

Construction, Maintenance and Practices for Locomotive Diesel Fuel Unloading

Chairman: Preston Sargent, Mgr.Mech.Sys.Dsgn., UP, Omaha, NE
Committee: Homer Kann, B&B Supvr., Conrail, Altoona, PA
Tom Hedberg, P.E., TKDA, St. Paul, MN
Trent Hudak, Project Engr., BN, Fort Worth, TX
Chuck Mader, P.E., Hanson-Wilson, Kansas City, MO
Walter Sturm, Sr. Project Engr., EJ&E, Joliet, IL

I would like to thank the board for inviting me to give this presentation. Before I get started, I wish to thank the 16 railroaders who contributed to the committee survey and my committee for the work put forth to produce this report.

The scope of Special Subject Committee No. 1 was to be the construction, maintenance and practices of locomotive fueling facilities. In 1991, American railroads used nearly three billion gallons. This means that we are pumping fuel to the tune of about 5,300 gallons per minute every minute of every day. The typical locomotive fueling facility is a combination gas station and Jiffy Lube built on a huge scale. These facilities are extremely complex as they are the focal point for as many as 12 different systems such as lube oil, fuel, radiator water, toilet dump, waste water and others. These facilities represent a major commitment by a railroad. They are expensive to build, operate and maintain. They also represent a large economic risk from an environmental standpoint. I have heard of fines as large as a half million dollars at one fuel site for fuel spill handling and have been told that it can cost up to \$20 to \$30 per gallon to clean up spilled fuel.

I should state at this time that any statistics that I will be using were derived from a survey conducted by the committee. Many of you expressed interest in the construction of these facilities. Our survey indicated that 71 per cent of new facilities and 48 per cent of rehabilitation projects are constructed by outside contractors and this trend is expected to continue.

However, this survey also indicated that railroad personnel are utilized 100 per cent to inspect and coordinate the construction of fueling facilities requiring us to be extremely familiar with the construction process.

Due to the complexity of the facility and my limited time, we will cover only some of the important components and/or considerations that go into the construction of a modern facility.

The facilities being built today incorporate features which are designed to meet current and probable environmental regulations. Therefore, many of the things we will be looking at are concerned with this aspect of the construction.

First, let's look at the site. Every site is different and will have different problems. The one common denominator seems to be that in 91 per cent of the sites you will find contamination, and in 56 per cent of the sites you will find an unknown obstruction.

These slides show several sources of contamination, leaking pumps, tanks, tank water draw offs, and incorrect installation. Note the drain pipe from the pump house is discharging into a sump with an earth bottom or drip pans that leak. Unknown obstructions are usually buried track material or old building structures. Unless you are fortunate to be in a totally

Fuel Facility Systems

- Diesel Fuel
- Lube Oil
- Radiator Water
- Journal Oil
- Raw Water
- Compressor Oil
- Soap-Wash
- Toilet Chemicals
- Central Vacuum
- Toilet Dump-Sanitary
- Storm Water
- Industrial Sewer
- Sand
- Compressed Air

Start-Up

Start Slow Monitor System Performance

- Open And Close Valves
- Verify Safety/Relief Valve Operation
- Check Gauges
- Trip Set Points
- Noise Or Vibration
- Meters Turning

new site and not adjacent to an existing facility, do not be surprised at what you uncover.

The next few slides show some of the in ground structural work that is usually done. I am sure you are aware that we are usually working very closely to existing trackage, most of which is live. For shallow work, shoring may not be needed. However, for deep work, deep piling or shoring will be needed. Note the hidden slab in the background. This was found, of course, when we started construction on this project.

Only 64 per cent of the railroads who responded to the survey have a company standard for working adjacent to trackage, but 73 per cent use shoring and 82 per cent use flagmen or some other form of precaution. When excavating, construction next to live tracks must be coordinated with the roadmasters, the operating department, and construction personnel to ensure a safe project.

This next slide shows an installation of a secondary containment membrane. The selection of a membrane can be a difficult task because of the claims made by the suppliers. Generally a PVC is not recommended for long-term exposure. This membrane went down very fast in just about three hours. It took several more hours for the factory representative to seal the seam and pipe penetrations. Factory representatives will normally do this because of warranty and liability considerations. With this manufacturer, the membrane is packaged to be easily rolled out and fitted to the site. Its fuzzy appearance is due to having a geotextile cover.

As long as we are in the dirt, let's look at a couple of other things. Here we have a drain line being assembled. I would recommend either a glued or fusion joint for drain lines because there is less chance of oil escaping into the environment and because the standard drain line "push-tite" gasket is usually rubber which deteriorates in the presence of petroleum products.

This series of pictures shows fiberglass pipe installation, both single wall and double wall. This slide shows beveling the pipe end in preparation for gluing. Next is applying the glue to make the joint. Note that care must be taken to keep dirt and debris away from the glue if possible. You might want to assemble piping outside the trench and only assemble in the trench when you have to.

These next two slides show the assembly of a double-walled pipe joint. These pipes usually come precut and beveled and ready for assembly. Fiberglass glue joints may require a heat blanket if the ambient temperature drops below 70 degrees. This picture of wrapped steel pipe shows a real bad situation. If deep cuts or portions of the pipe wrap are removed, they should be recoated and taped before burial.

This slide is supposedly an insulated flange which has several nuts tightened to the point where the insulating washer has broken and fallen out. A break in the protective coding or insulating joints will intensify the corrosive effect.

This picture shows corrosion pitting. The discolored spot in the middle of the pipe is a corrosion pit and it was caused by incorrect installation. This steel pipe is insulated and heat traced. This type of installation requires extra care because there will be no corrosion protection because of the insulation. It is very important that the jacket be installed correctly. If not, the insulation will deteriorate.

Here the piping and conduits are being stubbed and the ends covered to keep from being filled with soil. Of course, the soil is being placed in compacted lifts and the piping properly bedded to reduce the chance of joint separation or break.

What is the magic answer as to what type of pipe or pipe system can be used to cure the problems with pipe corrosion, UV deterioration, chemical deterioration, over pressurization, and secondary containment factors? I am here to say that there is no one answer. Each type of material has its own problems. Correct installation is the key to getting a good system no matter what the material. The material selection must be based upon the system operating parameters and the type of liquid being handled. My personal method is when in doubt, build

Testing The System

- A. Fill Test The Tankage**
- B. Flush Pipe Lines**
 - 1. Clean Strainers**
- C. Pressure Test**
- D. Check Motor Rotation**
 - 1. Amp Draw**
 - 2. Phase Balance**
- E. Check Alarm Set Points**

Environment Protection

- **Spill Containment Structures**
- **Membranes**
- **Doubled Walled Piping**
- **Double Walled/Bottom Tanks**
- **Computerized Inventory Control**
- **Storm Water Control And Treatment**

for stout because as you are well aware, Murphy was an optimist.

Jumping to the structural side, we have a man here tying rebar in a pit. If you are wondering about the water and mud, this is sheeted pile with a trim sealed bottom. The water is seeping through the sheet piling and pumps are being used to keep the pit somewhat dry.

Here are several shots of vertical formwork. This slide shows the water stopped in a structure. With increased demands for facilities that must provide for spill containment, the proper installation of water stops takes on much more importance than it has in the recent past.

Now that we have taken a very quick and dirty look at some of the underground construction, let's move to the above-ground facilities. As this picture shows, getting above ground with all the different systems can sometimes be a job by itself. I think the most obvious component is, of course, the fuel storage tank. This picture is of a double-walled tank facility. Although it is not noticeable, there is an impervious membrane liner in this earthen and concrete dike. That is why you are seeing all the piping here above grade. In this particular instance, the tanks are a good distance from the servicing facility so the dispensing pumps are inside the dike. This type of installation creates another problem in that out of sight is out of mind and it can easily lead to pumps that are not maintained or visually checked with any regularity.

The darker soil around the control valve in the lower left corner of the slide would indicate a leak which went on for some time before being discovered and fixed.

Moving along to the service facility itself, we have a series of pictures from different railroads showing construction of a new facility. Despite all the servicing taking place at these facilities, fuel is still their reason for being. Here are several pictures representing two approaches being used for a fuel pumping system. Pictures one and two show a custom system designed to fit the particular needs of a site and are so-called custom built systems. Picture three is a skid-mounted factory built system designed to provide a package with pumps, meters, filters and controls on a common frame suitable for use at a wide range of sites.

The disadvantage is that it is not as economical in some cases as a custom build. However, it can be moved if need be, is easy to install, and when people are trained on them they do provide a standard, well-understood system for use across the railroad. It is my understanding that additional standard packages are being developed for other areas such as compressed air, lube oil, radiator water, chemical injection and others.

Another common factor of servicing facilities is spillage or drip collection. In this, there are also two approaches. One is the standard track pan approach and the other is the monolithic slab approach.

According to the survey, approximately 61 per cent of the collection systems are pan systems with fiberglass representing the primary selection at 42 per cent. The advantage of steel and fiberglass pans is that they are economical, easy to install, and easy to remove. The concrete pans are more expensive, not as easy to install, but are less of a slipping hazard. All the pan systems can be installed without taking the track out of service for a long period of time. However, the pans also are prone to damage and leakage through the joints.

For the system to be properly installed, a secondary containment membrane should be put underneath them. This adds to the cost and requires the track to be removed and out of service for several days to install the membrane. The slide shows a typical membrane installation under a drip pan. There is a problem with track pans. When the track maintenance people come through, they may be careless. If you do not supervise their actions, they are liable to fill the cross drainage with valves, raise the track structure so the pan connections are no longer connected to the drain lines, or break the pans.

Approximately 39 per cent of the spillage and drip collection system is by poured concrete structure. This is more expensive to install and requires removing the track from

Maintenance Programs

- 1. Prepare Maintenance Program Based On:**
 - A. Manufactures Recommendations**
 - B. Personal Experience**
 - C. Expected Usage**
 - D. Current Maintenance Schedule**
- 2. Typical Programs**
 - A. Calendar - Monthly, Yearly, etc.**
 - B. Hour Meter**
 - C. Fix It When It Breaks**

Maintenance Problems

- 1. Sand Plugged Drains**
- 2. Leaking Nozzles**
- 3. Housekeeping**
- 4. Leaking Hoses And Pumps**
- 5. Leaking Valves**
- 6. Heat Tape Failure**
- 7. Waste Water Equipment Controls**
- 8. Filter Problems**
- Fuel Column Fittings**
- Surge Arrestors**
- Freeze-Ups**
- Human Error**

service for the longest period of time. If done correctly, it does provide better containment, requires less maintenance and is safer to work on.

Now, I realize we have skipped through the construction of a fuel facility, but, and let me emphasize this, we are no longer the primary design or construction people. However, we are the primary inspectors and site coordinators. Therefore when we are assigned to a project, we should review the drawings and specifications, discuss with the engineering department or consultants to determine critical items to check during construction, and be aware of standard construction procedures and materials to make sure we get a good job.

Keep a project log with your observations and discussions concerning the project and dates and names if required. Prepare a call list in the event of a problem or an emergency. Give a copy to the contractor or the local company agent. Only 64 per cent of inspectors are going to be stationed at the construction site. Also give a copy to your supervisor and the engineer or consultant on the job. Require a construction schedule of the coordinator to assist in coordinating track outage or the need for flagmen. Make sure the contractor adheres to railroad safety procedures and that he understands what he must do to comply with your specific needs.

If railroad personnel must perform some action such as removing rail, disconnecting power, closing off valves or pumps, the timing of these requirements must be determined and scheduled to eliminate contractor work stoppage or project delay. Make sure the contractor contacts you at each milestone of the project for your inspection and verification prior to proceeding. Also check that the local building inspectors have signed off for each person and for each section where appropriate.

The easiest method of field inspection is to use your eyes. Check such items as the condition of material arriving or being stored at the site. If a truck comes in with the concrete pans damaged in transit, if spotted immediately they can be replaced before their absence becomes critical to the project. It is very important that construction material and equipment be properly checked.

Once you get to the end of a project, and hopefully you inspected properly along the way, there remains the testing and start-up of the system and components. Actually some of the testing will be done long before the end of a project, but it is summarized here. First, have all building inspectors completed their sign-offs? If so, let's do some simple verification. If there are tanks, they should have been filled with water after erection to be sure they did not leak. Never test a standard liquid tank with compressed air. After the tanks have been filled, monitor their level for several days to check for slow leaks.

In preparation for testing piping, flush the lines with water to force welding slag, dirt, and other debris into the strainer. Pull the strainers and clean them. Do not have petroleum filters in place for this portion. After the lines have been flushed, they can be pressure tested. Please note that flushing is not the only way to clear a line, but it is the most common.

Pressure testing can be done either by hydrostatic or air testing. The hydrostatic test is the preferred method because it is the safest and allows for the easiest detection of leaks. A pressure test is usually done at 150 per cent of operating pressure. If there is a secondary containment system, it may or may not require pressure testing to full pressure, but at some pressure determined by the engineer to confirm its integrity. This could be possibly in the 20 to 25 pound range.

The next check is the electrical portion. Some items may, again, have been checked earlier, but typically I would bump a motor start to verify direction of rotation. An electrician can check the phase balance, amp draw and alarm set points. Hopefully now you have some assurance that if you fill the system with fuel, you will not get a leak.

Now will come the acid test of accepting delivery and dispensing fuel. Once the acid test starts, the system building gauges should be checked for system performance, the opening and closing of valves, the pressure relief system response, meters turning, and suspicious noises or vibrations.

Be sure to have skilled people around so that if a problem does occur, it can be diagnosed and, hopefully, cured without having to pump it all down. Do not be surprised if glitches and/or equipment failures happen during your first week of operation. Be prepared to call the contractor back as often as necessary to do warranty work. Believe it or not, the engineer could have made a mistake that will require a modification or an adjustment. Therefore if a system keeps developing problems that are either major equipment problems or a system design problem, it should be called to his attention. A nice finishing touch is to have operating instructions permanently mounted for operating personnel to review.

Having looked at the construction, let's review the maintenance aspect. I'm sure it comes as no surprise to you that 78 per cent of maintenance and 89 per cent of inspections of the facilities are done by railroad personnel. What did come as a surprise to me is that 82 per cent of the railroads that responded to the survey claim to have a maintenance program of some type. The system I am familiar with is when it does not work, fix it or replace it.

The survey indicated that the primary means to determine the maintenance was on a time or calendar basis such as every year lube the bearings or change the oil. This may or may not be okay. A better method is by the hour meter which equates actual usage to maintenance needs.

It is a good idea to require the equipment suppliers to provide several copies of installation, operation and maintenance manuals with this equipment. The ideal being to have one copy at the equipment site for use of the maintenance personnel and another kept on file by the maintenance manager responsible for the system. I have no idea why, but for some reason the maintenance manuals appear to be thrown away as part of the unpacking process.

The following is a list of the maintenance problems reported by the people who responded to the committee's questionnaire:

The number one item listed by 91 per cent of the respondents is sand plugged drains. This problem requires two things to be done. One, building a grit trap into the draining system; and two, getting the operating personnel to wash the servicing areas more frequently and run water into the drains for a longer period to carry the sand to the grit trap.

Item two with a 73 per cent response was leaking fuel nozzles. There is not much that can be done about this inhouse; however, we are currently working with manufacturers to produce a better nozzle.

Item three at 56 per cent is housekeeping. This covers such items as brush clearing, painting, spill clean up, and other miscellaneous items.

Items four and five were two items with a 33 per cent frequency. One is leaking hoses and the other is leaking pump seals. Hoses can be changed for a woven wire covered hose and the addition of a swivel at the fuel nozzle will improve their life.

The leaking mechanical seals are something that probably cannot be totally eliminated because it is primarily a function of wear. Note this carefully piped coffee can pipes the drip-page to an earth sump.

Item six at 27 per cent is a leaking valve. This is a very general statement and could cover the stem packing or internal valve seating. For stem packing, the best solution is to use a good quality Teflon packing material. This may not eliminate leaks entirely, but it should help reduce the problem. A leaking valve seat is a result of wear as liquid can cut the seat or it could be a noncompatible material and, of course, valve seats lose resilience over time.

The remaining items are heat tape failure and oil water separation control problems at 22 per cent. At 10 per cent each are fuel nozzle shut off failure, filter problems, fuel column fittings, surge arrestors, freeze-ups and human error.

Now in finalizing the presentation, it was asked of this committee to look into the old crystal ball and attempt to pick out trends in the construction, operation and maintenance of fueling facilities. This slide represents a computer-generated picture of Union Pacific's concept and we have a videotape here that our department generated that might be of some interest to you.

(Whereupon there was a video presentation)

The area of construction will see major changes as environmental rules mandate greater spill containment and control measures. These new rules will probably mean there will be a greater use of membranes, double-walled pipe, double-bottom tanks and more sophisticated inventory control systems.

We are going to be required to prove that we are not spilling fuels and oils into the environment. Additionally, storm water regulations will require that we either capture and/or treat rain water that hits or enters the fueling site or we must prevent storm water from hitting the site entirely. This may mean roofing over fuel sites. That creates another problem due to the diesel fuel exhaust fumes which will not be discussed at this time.

These environmental regulations may also lead to greater demands upon the railroad to inspect and maintain the facilities and keep better records on fuel receipt and dispensing. Another possible future is alternate fuels such as LNG, which will have major changes in the type of facility that is being constructed, how it is operated, and how it is maintained. LNG locomotives are currently being tested, but facility requirements and operational needs have not been determined.

There is some trend towards modular construction of the facilities. That is, modular manifolded tanks, coupled with pump skids and drip pans, can be moved as traffic patterns change for a very minimal cost.

Also being tested is a so-called supertanker which is operated by an outside contractor. The intent is to reduce the initial cost of a fueling operation by eliminating fixed fueling sites and attendant environmental measures. The jury is still out on whether or not this will prove to be a realistic idea.

You are also aware of another trend which shows signs that it will continue to grow and that is the use of outside contractors. Part of this is due to evolving state and local regulations that construction be done by licensed contractors or tradesmen. Of course, there is also a perception by railroads that a reduced employee base is desirable.

The survey indicates that outside contractors are making inroads into the maintenance portion of our work. The survey results indicate that may be because we are not educating our personnel. The systems currently being developed contain an increased number of electronic and mechanical controls which our people are not being trained to service. The survey indicated that there are only a few railroads that are training their people. It may be possible to supplement our people's training by using outside manufacturers or suppliers to provide short demonstrations or training courses on their equipment at the jobsite at little or no cost.

This concludes the presentation for Special Subject No. 1. I thank you for your attention.

Member: The state of New York has imposed quite a heavy tax on diesel fuels and we have been moving some of the fuelings from Buffalo, Selkirk and Albany into Cleveland, reopening fueling stations in Cleveland and savings thousands of dollars a day.

Mr. Sargent: Thank you for your statement.

President Saletnik: Thank you, Preston. I know your committee worked hard on that. (Applause)

Our next committee chairman is Jose Quesada, chairman of Special Subject No. 2. Jose began his railroad career as a rodman and engineering draftsman in 1967 with the Santa Fe. He continued to move through the engineering positions to his current one of steel bridge inspector. Jose has a Bachelor of Science degree in civil engineering from California State University and an ACI certificate as a concrete fill testing technician, Grade I. His professional memberships include the American Railway Bridge and Building Association, AREA, and the Society of Hispanic Professional Engineers. Jose.

Mr. Quesada: We are here to present to you a report entitled, "Cast In Place Concrete

Quality Control.” Jim Birgenheier, my co-chairman and good friend, has 28 years with the Burlington Northern. For the last 12 years, he has been involved in concrete quality control. Jim has put together a series of slides for this presentation for you. Jim, if you would come up.

Standing Subject No. 2

Cast In Place Concrete Quality Control

Chairman: J.M. Quesada, Steel Bridge Insp., ATSF

Co-chairman: J.A. Birgenheier, Engr. Materials, BN

Thank you, Jose. Only by understanding the fundamentals of concrete can such a structure be built and be made to endure the environment for decades. Concrete not only serves as a durable utilitarian material for streets, highways, and bridges, but it also provides versatility and economy and attractiveness to buildings.

Concrete has a wide variety of qualities. It can be placed by a wide variety of methods. Concrete can be proportioned and specified to eliminate or minimize potential for damage. Generally, the performance of concrete can be judged by the quality of the ingredients. Our purpose here is to address practical, effective and efficient methods of concrete work, and to promote quality control which will provide long-term durability and usefulness.

One component of concrete is water. Batch water should be clear, clean, and potable. It should be free from injurious oils, alkalies, salts, acids, and other organic materials that may be injurious to concrete or reinforcements.

Another primary component of concrete is aggregates. Coarse and fine aggregates must be clean, hard, strong, durable particles free of absorbed chemicals, coatings of clay or other materials that could affect hydration and bond. Though natural deposits of sand and gravel and various rocks are abundant and widespread, suitable sources must be identified and quarried.

After excavating and rough crushing, they are put through screens to separate into rough sizes. Later they are put through washers and screened to finer gradations.

The water requirements for concrete of a given consistency decreases as the maximum size of coarse aggregate increases.

There are four states of moisture conditions:

1. Oven dried, fully absorbent.
2. Air dried or partially water filled, somewhat absorbent.
3. Saturated, surface dry or SSD, neither absorbing water from nor contributing water to the mix.
4. Damp or wet, containing excess moisture.

The amount of water used in the concrete mix must be adjusted for the moisture conditions of the aggregate. Surface moisture on fine aggregate can cause considerable bulking.

Here is a slide of some fractured porous aggregate which is a source of distress. Pop-out is also another aggregate problem caused by swelling as certain aggregates absorb water, expansion of saturated aggregates as they freeze, or alkali aggregate reactivity.

The third primary component of concrete is cement. Cement is delivered in generally two forms; either bags of Portland cement containing 94 pounds or the equivalent of one cubic foot, or for large batches, cement is transported by truck.

Five basic types of cement are general purpose, moderate sulfate resistance, high early strength, low heat of hydration, and high sulfate resistance.

In addition to the three primary ingredients in concrete, there are miscellaneous admixtures that enhance concrete workability, durability and replacement. These include but are not limited to air entrainment, water reducing, retarding, accelerating, and super plasticizers.

Finely divided mineral admixtures include fly ashes and natural pozzolans. Exotic materials such as silica fume, ground quartz, and rice husk ash replace a portion of the cement and can yield extremely high concrete strengths.

One of the greatest advances in concrete technology was the development of air-entrainment concrete. Today air entrainment is recommended for nearly all concretes, principally to improve resistance to freezing and thawing. It also increases the workability. This permits using a lower water content and lower water/cement ratio. Water/cement ratio is simply the weight of water divided by the weight of the cement.

This slide shows a slab that has been exposed to the environment for five years with the air entrainment and shows no degradation. This slide shows a slab that is just as old but it lacks air entrainment and you can see the obvious effects.

This slide shows benefits of entrained air and higher cement content after five years exposure in sulfate soil. This slide shows recommended air content for specific aggregate sizes and type of exposure. As you read across, you see a 3/4 inch maximum aggregate size for severe exposure. We should be shooting for about 6 per cent here. Super plasticizers permit lower water cement ratios and aid in placement.

For any project that we are doing, there is some type of specification that will be required. Typically we refer to AREA chapter 8 railroad specifications. In addition to railroad specific specifications, ASTMs for materials and specifications for concrete and its component materials give detailed requirements for limits of acceptability.

Portland cements are tested for their compliance to established standards for type, alkali content, etc. Tests for aggregates have two major purposes. One is to determine suitability and the other purpose is to assure conformity.

There are five factors involved in proportioning concrete. Once the end use, methods of placement and durability conditions are known, proper materials can be selected. Strength and durability are two key requirements. Strength and durability are directly related to the ratio of water to cement, not total cement content.

The combination of water and cement is called paste. Paste comprised of Portland cement and water binds the aggregates into a rock-like mass as the paste hardens because of the chemical reaction of cement and water called hydration. The quality of the concrete depends to a great extent upon the quality of the paste. In properly made concrete, each particle of aggregate is completely coated with paste and all of the space between the aggregate particles are completely filled with paste. The quality of the hardened concrete is determined by the amount of water used in relation to the amount of the cement.

Advantages of reduced water content are increased compressive and flexural strength, increased water tightness, lower absorption, increased resistance to weathering, better bonding between concrete and reinforcement, and less volume change from wetting and drying. The less water, the better quality of concrete provided it can be compacted properly.

This slide demonstrates an undersanded mix that would not provide sufficient paste to fill the areas between the aggregate. This slide represents an oversanded mix that is adequately filling the space between the aggregate, but is going to yield low strength. This slide depicts a properly proportioned mix.

Requirements for concrete exposed to deicers need a low water/cement ratio, sufficient

amount of cement, compressive strength 4,000 psi minimum, low slump, air entrainment from 6 to 8 per cent, well planned finishing quality aggregates, moist curing, and air drying.

Factors resulting in low durability are just about the opposite of the preceding slide; that is, a high water/cement ratio, inadequate cement, inadequate air, high slump, poor finishing, inadequate curing, and inadequate air drying.

This slide shows approximate mix water requirements for a given slump and particular aggregate size. Back in 1918, Mr. Abrams said, "For given materials, the strength of concrete depends solely on the relative quantity of water as compared with the cement regardless of mix or size and grading of aggregate." So it's not a brand new idea. It has been around a while.

The largest aggregate that should be used in any proportion should not exceed three quarters the space between rebar or one third the thickness of a slab.

Once we have quality materials and our batch proportions, we are ready to mix the concrete. Most concrete will be mixed in ready-mix trucks. There is a specification in ASTM that governs the mixing of concrete in the truck. When it is mixed in the truck, it is called shrink mixing. The volume is limited to 63 per cent of the drum volume. Seventy to 100 revolutions of the drum or blades at mixing speed are required to produce concrete of the specified uniformity. Not more than 100 revolutions at mixing speed are allowed. Mix speed is usually 6 to 18 rounds per minute. Agitating speed is usually about two to six rounds per minute.

Concrete must be delivered and discharged within one and a half hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates, or cement to the aggregates.

Now that we are ordering the concrete, we need to specify some things. We need to specify the course aggregate size, the slump, the air content, and the basis for proportioning using one of these alternatives.

Alternative number one is the purchaser deciding and specifying the cement content, the maximum water content and the admixture range and dosage. Compressive strength is not a criteria.

Alternative number two is that the manufacturer decides the proportions. All the purchaser does is specify the compressive strength.

Alternative number three is, again, the manufacturer decides the proportions, the purchaser specifies the cement content, the compressive strength and the admixture type range of dosage.

If we are going to monitor the amount of revolutions in the volume in a truck, we need to be aware of the rating plate that every ready mix truck is equipped with. This particular truck rated at ten cubic yards, meaning that this is its hauling capacity. However, this truck, if the concrete is mixed in it, is limited to 63 per cent of this. So it could only mix 6.3 yards. Also if we are going to monitor the number of revolutions on this truck, each truck must be equipped with a cab meter that is either zeroed out when it leaves the batch plant or the number is recorded so that the inspector or the one responsible can verify the amount of revolutions that the truck load has.

Once we get this ready mix concrete to our job, we need to do some testing on the fresh concrete so that we know it meets our requirements. The most commonly done tests on unhardened or plastic concrete are slump, air content, temperature, unit weight and cylinder preparation for strength. Accurate sampling is of major importance. Unless the sample is representative, the results will be misleading. The response of obtaining representative samples of fresh concrete for control must be emphasized. The sample must be used within 15 minutes from the time it is taken from the batch and must be protected from sunlight, wind, and other sources of rapid evaporation during this period.

The sample should not be taken from the first concrete out or the last concrete out, but from the middle of the truck. The temperature measurement can be taken from this sample.

Seventy-five to 100 degrees for hot weather placing and 40 to 55 for cold weather placing is acceptable.

A slump test should be done. Generally, concrete is specified for the least slump which can be conveyed, worked, and placed. Least slump means least water and highest strength and durability. The slump cone must be filled in three equal layers of approximately the same value and each layer individually rodded.

Here are a couple tools that you use in doing the fresh air testing, one being the rod and the other being a mallet that is used on the air chamber in the cylinders. Here is a cylinder being filled one third. It is being rodded 25 times. This process is repeated three times and the cone is inverted and the slump is taken. On this particular sample it looks like it is about one 3/4 in slump.

Test for air content. Air content is calculated in cubic feet per cubic yards of concrete. Air is based on the requirement of durability. An air entrainment test is desirable for each sample from which a cylinder is made. It is made very much the same way as the slump cone in that it is filled two-thirds and rodded 25 times and wrapped after the rodding.

This slide shows the final fill leveled off and the air test being made. This particular test was nearly 7 per cent.

Test for unit weight. Despite the simplicity of the test for unit weight of concrete, results can be sufficiently accurate to determine the quantity of concrete produced per batch. The test can also give indications of air content. A balance, or scale, sensitive to one tenth of a pound is required. Care is needed to consolidate the specimen adequately and strike off the surface so that the container is filled properly. The container should be calibrated periodically.

One consideration which sets concrete apart from other materials is that it is ordered, purchased, and used by volume. It is batched by weight however. The yield of concrete is of concern in order to verify the delivered volume of materials. Yield is calculated as the sum of the batched weights times the tested unit volume weight.

When making and curing cylinders, specimens for strength tests should be made and cured from each sample. The standard test specimen for compressive strength of concrete with maximum aggregate size of two inches or smaller is a cylinder 6 inches in diameter by 12 inches high.

For larger aggregates, the diameter of the cylinder should be at least three times the maximum size of the aggregate and the height should be twice the size of the diameter. Test cylinders should be filled and rodded in approximately three equal layers similar to what was done on the slump test and air test. It should be consolidated either by rodding or vibrating. Concrete with a slump in excess of three inches, however, must be rodded. Concrete with a slump of less than one inch must be vibrated. Either method can be used for one to three-inch slump concrete.

The strength of a specimen is greatly affected by jostling, changes in temperature, and exposure to drying, particularly within the first 24 hours after casting. Thus test cylinders should be cast in locations where subsequent movement is unnecessary and where protection is possible.

Cylinders should be protected from rough handling at all stages. Strength tests of hardened concrete can be performed on specimens molded from samples of the concrete being used or on specimens cored or sawed from hardened concrete. Test results are greatly influenced by the condition of the specimen.

The design properties of fresh concrete mix will differ depending upon the means of transporting the concrete from the mixer to the project. In general, the concrete needs to be workable enough to be easily transferred by the transporting equipment, but cohesive enough not to segregate during delivery and placement. Also there should be no loss of workability due to handling. Finally, bleeding should be kept to a minimum at all stages of placement.

One method of delivery is front discharge which gives the driver the ability to see where

he is depositing the concrete. He can't see where he is going when he leaves, though.

This slide shows the more conventional way. Although you can't see the truck, you can trust me that this is a rear discharge. Buckets used on cranes enable full versatility of cranes and cableways to be exploited. Buckets convey concrete direct from the central discharge point to perform work and/or to the secondary discharge point.

Belt conveyors are used for conveying concrete horizontally or to a higher level and are usually used between a main discharge point and a secondary discharge point. This is not suitable for conveying concrete directly into the form. Belt conveyors are able to deliver high volumes of fresh concrete, lower slump concrete to central locations into a buggy, wheelbarrow or bucket. Typically belt conveyors will convey all concrete proportions with ease except those of higher slumps which are prone to segregation. Low or no slump concrete can be conveyed very effectively by belts.

Often when the means for conveyance is known, the use of special additives can be considered for concrete pumping. For example, additives such as fly ash can enhance pumpability and super plasticizers can yield very high slumps. Also in the case of pump mixes, the maximum aggregate size may be limited to 40 per cent of the pump line inside diameter and often more.

Finally, most mixes have better transporting qualities when air is entrained. Most concrete is delivered by a truck mixer and put in place with the trucks chute. However, segregation and slump loss should be considered and minimized by the mix proportions and methods of placement. The most obvious precaution of this method of delivery is to minimize the drop, drops over six feet, from the end of the chute to the form.

Both buggies and wheelbarrows are labor intensive. They are good only for small loads and useful only for short horizontal hauls. Trucks, on the other hand, deliver huge volumes quickly, but are appropriate only for delivery on large concrete projects.

Preparation prior to placing concrete includes compacting, trimming, placing, vibration, and moistening the subgrade, erecting the forms, and setting the reinforcing steel and other embedded items securely in place. Moistening the subgrade is important especially in hot weather to keep the dry subgrade from drawing water out of the concrete.

Forms should be accurately set, clean, tight, adequately braced, and with enough clearance between forms and reinforcing. Forms shall be constructed of or lined with materials that will impart the desired formed surface finish to the hardened concrete. Wood forms should be moistened prior to placement of concrete otherwise they will absorb water from the concrete and swell. Forms should be made for removal with minimum damage to the concrete. Forms should be treated with a release agent such as oil or lacquer to facilitate removal.

Reinforcing steel should be clean and free of loose rust or mill scale when concrete is placed.

Concerning reinforcement, the bar size number indicates the diameter to one-eighth of an inch. In other words, if I have number five bar, that's five-eighths of an inch. It must be clean, free from pitted rust, and properly placed.

In general, concrete should be placed in horizontal layers of uniform thickness, each layer being thoroughly consolidated before the next is placed. The rate of placement should be rapid enough so that the layer of concrete is plastic when a new layer is placed upon it. This will avoid flow lines, seams, and planes of weakness that result when fresh concrete is placed on hardened concrete. It should be placed near its final location. Don't flow or move concrete with a vibrator and, again, no drops over six feet.

Consolidation is the process of compacting fresh concrete to mold it within the forms and around embedded parts and reinforcement and to eliminate stone pockets and entrapped air. Consolidation is accomplished by hand or by mechanical methods. Vibration, either internal or external, is the most widely used form of consolidating concrete.

When concrete is vibrated, the internal friction between the coarse aggregate particles is

temporarily destroyed and the concrete behaves like a liquid. It settles in the form under the action of gravity and the entrapped large air bubbles rise more easily to the surface. When vibration is used to consolidate concrete, a stand-by vibrator should be at hand at all times in the event of a breakdown. Internal or immersion type vibrators are often called spuds or stingers. Proper use of internal vibrators is important for best results.

Whenever possible, the vibrator should be lowered vertically into the concrete at regular intervals and allowed to descend by gravity. It should penetrate quickly to the bottom of the layer being placed and at least six inches into any preceding layer. The vibrator should be held stationary for 5 to 15 seconds until adequate consolidation is attained and then slowly withdrawn. The concrete should move to fill the hole left by the vibrator. If the hole does not refill, reinsertion of the vibrator at a nearby point should solve this problem.

External vibrators can be form vibrators, vibrating tables, or surface vibrators such as vibrating screed, plate vibrators, vibratory roller screeds, or vibratory hand floats or trowels. Form vibrators, designed to be securely attached to the outside of the forms, are especially useful for consolidating concrete in members that are very thin or congested with reinforcement, to supplement internal vibration, and for stiff mixes where internal vibrators cannot be used. Attaching a form vibrator directly to the form generally is unsatisfactory. Rather, the vibrator should be attached to a steel plate that in turn is attached to a steel I-beam or channel passing through the form stiffeners themselves in a continuous run. They should be faced to distribute the intensity of the vibration uniformly over the form.

Honeycombing is the result of poor placement techniques, lack of or improper vibration, or poor workability. Concrete can be placed properly on slopes by following the suggestion on this slide. Some other means of concrete placement are with a screw conveyor, dumping concrete directly from a truck, roller screed, a tremie for underwater concrete placement, roller compacted concrete and shotcrete.

Concrete should not be placed in the subgrade or forms more rapidly than it can be spread, struck off, consolidated and bullfloated or darbyed. In fact, concrete should not be spread over too large an area before strike off, nor should a large area be struck off and bleed water allowed to accumulate before bullfloating or darbying.

Strike off or screeding is the process of striking off excess concrete to bring the top surface to proper grades. The templet used in the manual method is called a straight edge although the lower edge may be straight or curved depending on the surface specified. It should be moved across the concrete with a sawing motion and advanced forward a short distance with each movement. To eliminate high and low spots and to imbed large aggregate particles, a bullfloat or darby should be used immediately after strike off.

The long-handled bullfloat can be used on areas too large to reach with a short-handled darby. For normal concrete, these tools should preferably be made of wood. For air-entrained concrete, they can be made of aluminum or magnesium alloy. After the concrete has been edged and jointed, it should be floated with wood or metal hand floats or with a finishing machine using float blades.

The purpose of floating is fourfold: One, to imbed aggregate particles just beneath the surface; two, to remove slight imperfections, humps and voids; three, to compact the mortar at the surface in preparation for later finishing operations; and four, to keep the surface open so excess moisture can escape.

Floating produces a relatively even texture that has good slip resistance and is often used as a finish. Floating should be followed by steel troweling. Troweling never should be done on a surface that has not been floated. Troweling only after bullfloating or darbying is not an adequate procedure. A slip-resistant surface can be produced by grooming before the concrete has thoroughly hardened but it should be sufficiently hard to retain the scoring.

Joints properly placed can avoid many problems. We know concrete is going to crack on big placements so a control joint is frequently sawed in or put in with some type of an insert

so that the concrete cracks at that point.

Construction joints are typically used from one day to the next. Casting and an isolation joint is used around structures such as posts or building walls.

This slide shows a gentleman making a saw cut. It is important that a saw cut is done before the concrete has attained 24 hours of age or it's going to crack where it wants to crack.

A procedure that is often compromised but is very important in quality replacement is curing. All newly placed and finished concrete should be protected from rapid drying, from extreme changes in temperature, and from damage by subsequent traffic and construction. Curing should begin as soon as possible after completion of the concrete work. Curing is needed to maintain the concrete at a relatively constant temperature and to prevent loss of moisture for the time necessary for proper hydration of the cement and strength gain of the concrete. With proper curing, the concrete will become stronger and more resistant to stress, abrasion, and frost.

Concrete can be kept moist and in some cases at a favorable temperature by three curing methods:

1. Methods that maintain the presence of mixing water in the concrete during the early hardening period. These include ponding or immersion, spraying or fogging, and saturated wet coverings. It is important not to let it dry out. Wetting and drying and wetting and drying is not beneficial.
2. Methods that prevent loss of mixing water from the concrete by sealing the surface. This can be done by coverage with impervious paper or plastic sheets or by applying membrane-forming curing compounds immediately after finishing.
3. Methods that accelerate strength gain by supplying heat and moisture to the concrete are typically done in precast plants and are not something that we are going to cover at this presentation.

The method, or combination of methods, chosen depends on factors such as availability of curing materials, shape and size of concrete surface, esthetic appearance, and economics. On flat surfaces such as pavements, sidewalks and floors, curing can be accomplished by immersion of the finished concrete called ponding. Continuous spraying or fogging with water is an excellent method of curing when the ambient temperature is well above freezing. A fine mist should be applied continuously through a system of nozzles or sprays. Basically then, our general curing requirements can be capsulized in saying that we need three to seven days of wet curing, temperature should be maintained between 50 and 100 degrees, and again should be kept continuously saturated.

We can place concrete in hot weather although there are some special requirements. The water demand goes up. Slump loss is greater. We have a faster set and rapid drying. Plastic shrinkage cracking is much more likely and the air content is variable. Precautions, however, can be taken to place concrete in hot weather by cooling the aggregates, cooling the water, cooling the subgrade forms, cooling the rebar, cooling the equipment, cooling the surroundings and curing with tepid water to avoid thermal shock.

One way to reduce concrete temperature is to sprinkle the aggregate piles to lower the temperature. Sprinkling the drum of a ready mix truck also helps reduce the temperature. Another way to reduce concrete temperature is to replace a portion of the water with ice. Direct injection of liquid nitrogen into a truck mixture will help cool the concrete. Plastic shrinkage cracks can be avoided by proper hot weather concreting techniques.

We can also place concrete in cold weather but, here again, some precautions are necessary. It's a good idea to use type three cement because we get a rapid strength gain. The cement content should be increased or cement type one and accelerator and then a warm curing.

Antifreeze solutions must not be permitted in concrete in cold weather or any other weather. The quantity needed to appreciably lower the freezing point of concrete is so great

that strength in other properties are seriously affected by their use.

Finishing the concrete surface can proceed because a windbreak has been provided. The temperature of mixing water needs to be considered in producing heated concrete of various temperatures. For accurate testing, cylinders must be protected in an insulated curing box.

Cold weather concrete construction can take place with proper enclosure and heat.

Another method to protect concrete in cold weather is by the use of insulating blankets. Heat can be added to enclosures but it must be properly vented or scaling will occur and toxic fumes are hazardous to workers. Frozen concrete gives us ice crystals in the concrete which prevents concrete strength gain. Improper curing and care causes dry shrinkage cracks. Employees involved with concrete placement need to be aware of skin irritation.

In conclusion, by using quality materials, providing for proper testing, placement, and curing, concrete can be cast-in-place to provide many years of durable service.

That concludes our Special Subject No. 2 report. If there are any questions, I am sure Jose will be glad to answer them. (Applause)

President Saletnik: Thank you, Jose and Jim. We now move onto our next presenter. Tim Rich is chairman of Special Subject No. 3.

Tim graduated from the University of Kentucky in Lexington with a Bachelor of Science degree in civil engineering in 1986. He also holds a professional engineering license and a land surveyor training certificate. Tim began his railroad career with Conrail as an engineering management trainee and advanced in the engineering department to his present position of engineer of B&B responsible for all aspects of approximately 2,000 bridges, 7,000 culverts and 200 buildings ranging from inspection, maintenance, and new construction. Tim.

Standing Subject No. 3

Upgrading & Retrofitting Steel Railroad Bridges

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D. Williams, Engr. Structures, Conrail, Dearborn, MI

Thank you, Paul. Good morning.

Upgrading and retrofitting steel railroad bridges is a maintenance procedure used frequently to maintain or increase existing load capacities or clearances of many steel railroad bridges today. Increasing emphasis on economics has made this type of procedure more feasible than total replacement of the structure.

This committee will address typical repairs and improvements to maintain or increase load capacities and clearances on steel railroad bridges. This report also identifies some of the fatigue prone areas that require the repair in the first place.

However, before a repair or improvement can be made to a particular member or section of the structure, the structural condition of the entire bridge or span must be examined to determine if consideration should be given to replacement of the structure.

Existing Load Capacity

Steel bridges have proven their functional durability with such 100-year-old examples as the Brooklyn Bridge in New York City and the Eads Bridge over the Mississippi River in St. Louis. As some of you may remember, the history of the Eads Bridge was presented at the 100th anniversary of the American Railway Bridge and Building Association held in St. Louis two years ago.

Durability for any bridge comes at a price. That price is regular maintenance, repair, and upgrading.

Most of today's steel railroad bridges were designed and built approximately 80 years ago. The designers of that era were concerned greatly by the weight and impact loading of the steam locomotive. Their concern has become what the engineers of today refer to as the needed overdesign to handle our existing freight car and diesel locomotive weights. Not only does the weight of a 315,000 pound freight car play a significant role in the life-span of steel bridges, but the impact loads as well can take their toll on a bridge.

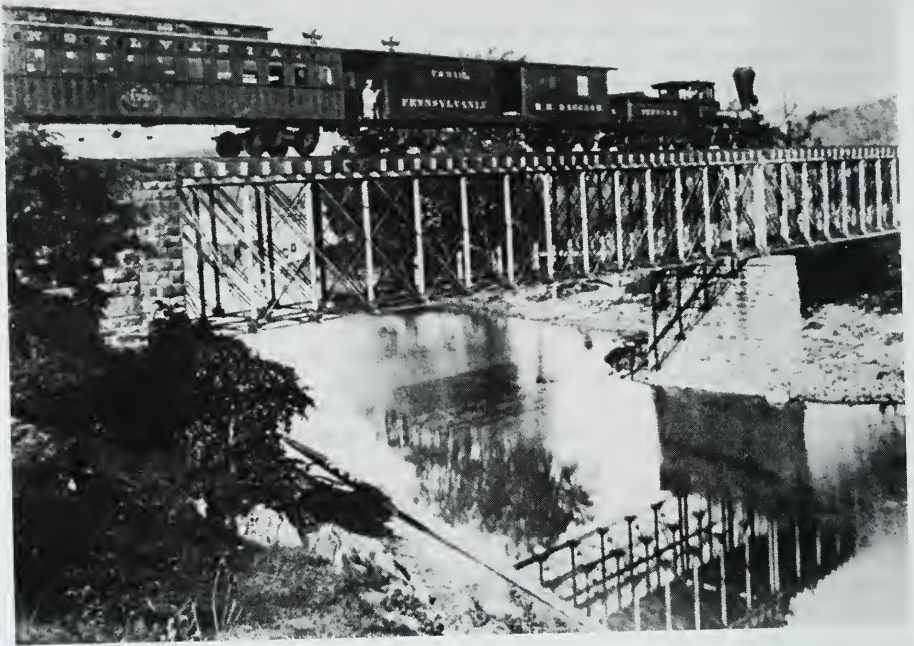
Common types of superstructures of steel railroad bridges include deck girder, thru girder, I-beam, thru-truss, and deck truss. Other types of steel structures are in use today by many roads, but this committee will concentrate on the most common types as mentioned earlier.

Substructures are commonly constructed of concrete, masonry, or timber, but in some situations steel is used. Probably the most common type is the steel pier and truss tower. The connection of these bridges' superstructures and substructures is a significant part of design whether they are riveted, bolted, or welded.

In addition to increased loadings over the last several decades, reduced structural integrity significantly reduces the usefulness of the bridge if it doesn't meet the required load capacity for that particular route. Reduced structural integrity can be attributed to three major causes: damage, corrosion, and fatigue. Damage to a steel railroad bridge is primarily caused by collision by another object. Train derailments may cause significant damage to a thru-truss or thru-girder bridge if they don't have a guardrail to help keep the cars in alignment during the derailment.

Steel railroad bridges that cross over highways are susceptible to vehicular damage. This damage is usually caused by a truck not adhering to posted clearance signs and striking the steel superstructure. These bridges are the most commonly damaged and the amount of damage can range from scraped rivet heads to bent bottom flanges to total structural loss of the bridge.

Steel bridges are susceptible to fire damage, but not in the same way as a timber bridge. These bridges will suffer plastic deformation when temperatures at the exposed steel exceeds 1,200 degrees Fahrenheit. The degree of damage will depend on the maximum temperature and the duration of the exposure. Depending on the member and how severe the buckling is, the only alternative may be replacement of the member.



The early days of steam locomotives in the 1870's.



Impact by the Algonorth to a stationary span of a mainline movable bridge in Toledo, Ohio, in 1992.

Corrosion occurs over several years and is most common at the bearing areas of the bridge. Corrosion in this area is often caused by the build up of dirt and debris which will retain moisture. This moisture will then corrode the surrounding webs, stiffeners and flanges. Floor connections of ballast deck bridges will sometimes collect the dirt and debris causing reduction in the steel. Other members of the bridge may become corroded when the presence of water, dirt and debris are present.

Typical fatigue cracking among railroad bridges often occurs as the result of a bridge or member reaching the end of its life span or due to a poor design detail. The fatigue life is based on several items: the frequency of train traffic, the age of the bridge, the amount of live load and impact, the type of detail, the quality of the fabricated detail, and the material fracture toughness.

Desired Load Capacity

Each road must have a desired load capacity for their respective bridges. If it is found that a particular bridge does not meet the requirements, it may be necessary to conduct a detailed steel inspection and rating if the seriousness of the problem is not obvious. Before determining if repair or replacement is necessary, the following aspects of the bridge should be determined while keeping in mind the economics of the project: the chemical and physical properties of the steel, the environmental considerations such as the presence of airborne chemical fumes, persistence of water spray and tidal levels; structural condition of the member in question and the entire bridge; and redundant or fracture-critical member.

Typical repairs used in retrofitting existing structures to maintain these present load capacities are: T-sections, web plates, adding stiffeners, replacing individual members, and other reinforcements.

T-sections are often installed on girders and rolled sections at the bearing areas when the flanges, stiffeners, and webs become severely reduced. It is important that your repair design will not cause fatigue cracking as the result of poor design.

Before the existing section of steel can be cut away with an oxygen and acetylene torch, the surface of the steel must be examined for such items lead-based paint. If the conditions warrant, proper personal protective equipment should be worn. As an example, a respirator should be worn while torchcutting the steel in the area that may collect the harmful vapors.

Special attention should be given that a rounded corner be used to prevent fatigue cracking as seen in the slide. Once the old section is removed, the new T-sections may be positioned and welded in place.

Sometimes only the web of a member may become reduced. If that is the case, web plates may be added to each side of the structural member. The recommended procedure is to drill approximately four holes through the web of the member in the repair area. The number of holes will vary depending on the size of the splice to be made. Predrill the web splice plates to match the hole alignment. Bolt the splice plates to the web and then weld.

In order to obtain a snug fit with the top and bottom flange of a welded plate girder, stiffeners are cropped in the web to flange fillet weld area. This snug fit is necessary to prevent the rotation of the flange.

In this particular slide you can see the crack originating from what is called the web gap area. The web gap cracking is a result of the welding of the intermediate stiffener close to the web to flange fillet weld. Two repair procedures were used on this particular bridge. First, five-eighths of an inch diameter holes were drilled at the ends of the cracks and it was decided not to weld the cracks. Shorter intermediate stiffeners were to be field welded between the existing shop welded intermediate stiffeners. These two repairs were chosen to stop the rotation of the top flange and web gap cracking.

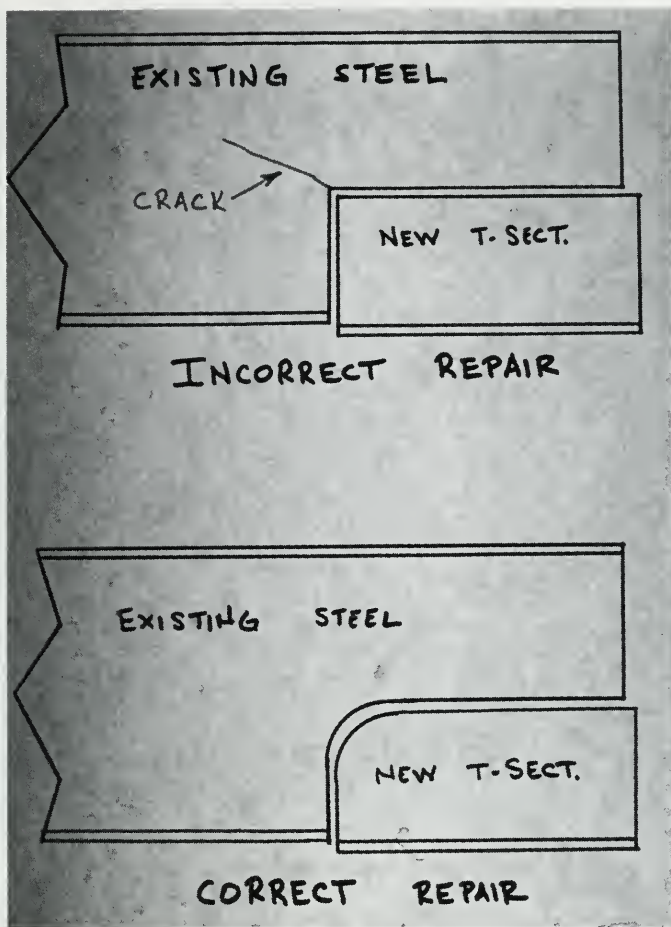
Often in riveted or bolted connections, it is desirable to replace that particular damaged



A detailed steel inspection requires a hands-on view.



Welding intermediate stiffeners.



T-section retrofit design.

member rather than adding an additional one as we just discussed. Damaged flange angles, lateral bracing, and truss diagonals are common types of member replacements to maintain the existing load capacity. Corrosion as well as damage is a typical reason for this type of repair.

A bottom flange angle of a riveted girder becoming severely reduced is known as knife edging. When this occurs, the rivets should be replaced with bolts until adequate track usage can be obtained to remove the bolts and install the new predrilled angle. The key issue to remember is that this type of procedure is more commonly used with bolted or riveted members.

As was mentioned earlier, corrosion can occur at floor connections. Attaching web splice plates is one of the alternatives as previously detailed. However, if the corrosion is in an area that cannot be repaired with web splice plates and it cannot be replaced economically, other reinforcements can be added to accept the live load.

On this particular bridge, the floor beam webs and top flanges at the concrete line were severely reduced. Steel straps were added. These straps were welded to the bottom of the bottom flange and the web of the girder above the floor beam connection. One was placed on each side of the web of the floor beam, rebar installed and concrete poured. This repair saved enormous replacement costs of the deck system and still greatly extended the life of the bridge.

Two options are typically used for cracked stringer or floor beam connection angles. One, of course, is simply to replace the angle. The second option is to weld in place what is called a figure four. Figure fours are small triangular-type objects welded to the existing connection angle after the crack has been welded.

Thru-girder ballast deck bridges sometimes require additional steel sections to be added to the flanges to account for repeated surfacing of the track structure. The accumulated ballast as a result of the surfacing increases the dead loads. Once a bridge reaches this condition, a load rating should be done based on the present steel condition. This bridge was acceptable for the tonnage and speed of the present rail traffic.

Post tensioning and flame shortening are two other types of repairs sometimes used as a repair method of tension members. If increasing the load capacity is desired, adding the necessary steel section or member may be the answer. A load rating analysis would have to be performed to determine what type of improvement would be the most economical to obtain the desired load capacity. Some typical improvements include adding cover plates, intermediate bents, stiffeners, stringers and other individual members.

Plate steel may be added to flanges. However, special attention should be given to the welding detail. If the end of the new cover plate requires an end weld, try to provide for a uniform radius weld from one side of the plate to the other. Traverse and point-tapered welds will cause fatigue cracking. If it is determined that reducing the span length would achieve the desired load capacity, the intermediate bent or bents should be placed at mid span if possible. Mid span is typically the point of greatest bending stress.

Retrofitting the existing steel structure is not always an option. Such variables as the amount of steel reduction as a result of corrosion, the amount of damage as the result of impact or a fire and the fatigue condition of the bridge may render the bridge structurally unacceptable for use. When conditions get this severe, total member span or bridge replacement may be the only alternative.

Before a commitment is made to either retrofit or replace, the economics must be considered. In today's economy where the buzzword is budget, we all want to make sure we are getting our money's worth. Therefore before we invest in a bridge project, we should ask seven questions:

1. How old is the structure?
2. Is the structure functionally obsolete?
3. What is the remaining life of the structure?
4. What is the expected economic future of that particular route?
5. Are there many other members with significant defects?
6. Can my company afford a major financial investment at this time?
7. What would the financial impact be if the bridge was removed from service?

Clearances

Clearances are significant economic development criteria. Vertical clearances vary across the United States. The one thing that doesn't vary from one railroad to the next is the continued effort of each road to improve clearances on their main routes.

Today special routing is designed to handle oversized freight. The vertical clearance on the rail lines is a direct link to the type of traffic. The type of traffic is dependent upon economic resources or requirements of that region of the country.



Web gap cracking from an intermediate stiffener weld.

An example of increased clearances is the use of tri-levels for the shipping of automobiles. This required changes in some overhead, signal, and thru-truss bridge clearances. To continue with another example, the use of double stacks again requires the original construction of some bridges to be modified to accommodate the new freight if it doesn't meet the 20-foot 8-inch threshold. Not only does a rail line with high vertical clearances mean better transit time for the shipper and easier routing for the carrier, it provides the opportunity for economic growth at all points in between.

In support of this economic development methodology, the State of Pennsylvania has committed \$33 million towards a clearance project across the state. That particular project has an estimated total cost of \$79 million to provide a minimum vertical clearance of 20 feet 8 inches for the rail shipment of double-stack containers.

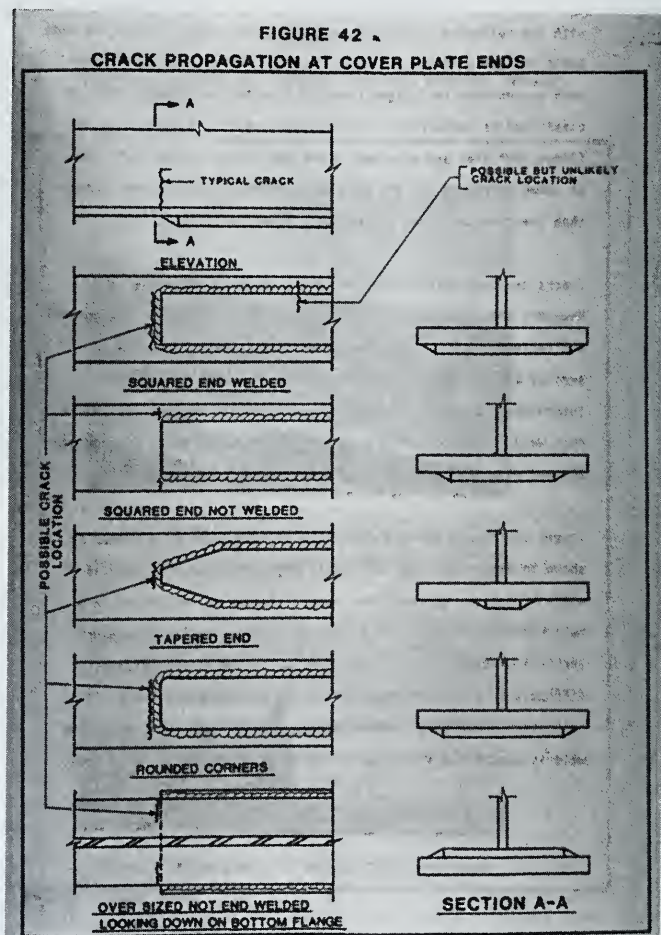
To provide these greater clearances, decisions of retrofitting or replacement are once again required. Retrofitting and replacement can be divided into two categories: undergrade and overhead structure.

Retrofitting undergrade structures is limited to two basic types of bridges: the thru-truss

and the thru-girder. Possible alternatives to increase vertical clearances on a thru-truss are to raise or replace the overhead lateral system or lower the floor system. Knee braces on both thru-trusses and thru-girders may be modified to accommodate a greater horizontal clearance.

Retrofitting overhead structures is limited. Raising of signal, pedestrian, and some highway bridges is the most common steel retrofit solution. Some non-steel retrofit options for overhead bridges include undercutting track, reducing the height of the rail, reducing the depth of the tie, and direct fixation rail support.

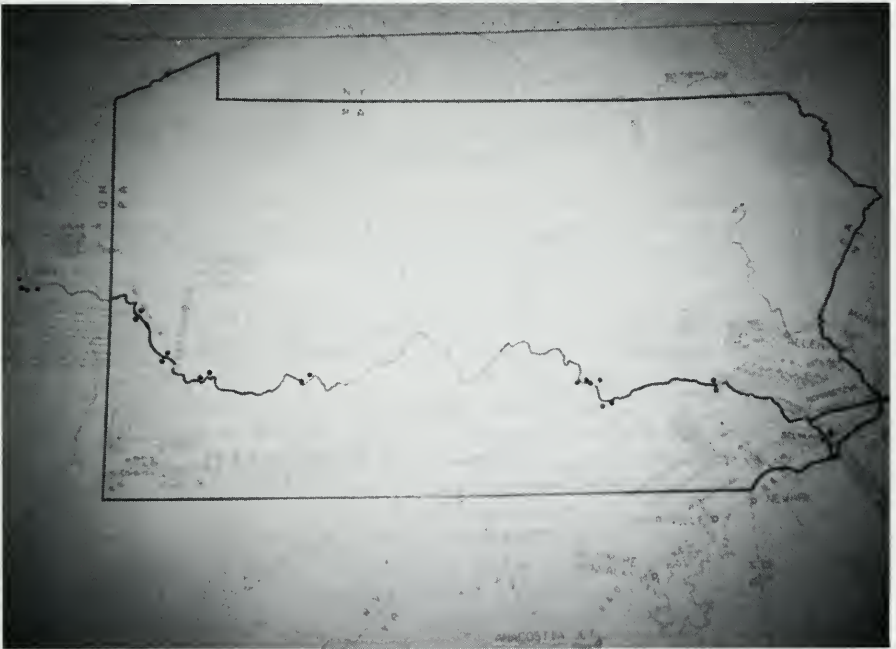
Replacement of a span for greater horizontal or vertical clearance can be costly. However, the investment can be justified if this bridge is of high financial importance for the economic development, transit time, and routing of that line. Again, economics of whether to invest in improving the clearance of an aging bridge with some poor structural conditions or install a new span must be determined.



Coverplate shape and attachment details that may cause cracking.



Overloaded ballast section of a typical thru-girder bridge.



Pennsylvania Clearance Project Route.

Conclusion

This committee has presented causes of decreased load capacity in steel railroad bridges. Such decreases are attributed to damage corrosion and fatigue. We have discussed typical retrofitting techniques of installing T-sections, applying web splice plates, adding stiffeners, replacing individual members, adding cover plates, installing intermediate bents, and attaching other reinforcements.

However, with today's economy and many years of deferred maintenance for some of the railroads, we must be sure that we are using both engineering skills and economics in our decisions. Thank you. (Applause)

Mr. Steele: Thank you, Tim, for that worthwhile presentation.

I would like to personally congratulate all of the presenters and their committees for excellent reports. The only way we can have this continue is through the participation of you, the members, of this Association.

Our next presenter is Del O'Neal and we apologize for the misspelling of your name in the program, Del. Del began his railroad career with the Southern Pacific while attending the University of Arizona in 1964 and has been with the Southern Pacific ever since. He currently holds a position of assistant supervisor in the bridge department in El Paso, Texas. Please join me in welcoming Del O'Neal. (Applause)

TURNBUCKLE REPAIR AND MAINTENANCE

Del O'Neal

**Assistant Supervisor - Bridges
Southern Pacific**

Thank you very much. I would like to talk today about turning the turnbuckles on a railroad bridge over the Rio Grande River in El Paso, Texas.

But first I'd like to give just a little history and description of the bridge. It is 1,692 feet long, originally designed for Cooper E40 loading and built in 1902. The main portion of the structure consists of five each 182-foot steel deck pin connected truss spans. The approaches are deck plate girders on concrete piers.

In 1925, the bridge was reinforced by adding a center truss to each of the main spans in order to obtain a Cooper E65 rating. In 1989, a joint inspection was made by Southern Pacific inspectors and Don Sorgenfrei of Modjeski and Masters Consulting Engineers and the conclusion from that inspection was that the bridge was basically in good condition except for numerous slack I-bars.

In 1990, the Southern Pacific bridge forces shrunk the I-bars and tightened the turnbuckles on the counters. We flame shrunk the I-bars pretty much in accordance with the instructions of the AREA manual, but we developed a machine to turn the turnbuckles which finally gets me to the subject of my presentation.

The first time I ever saw anyone turn the turnbuckles of a truss, they were using three-ton come-a-longs pulling on the handles. The system was not very effective and I felt it was quite dangerous. So when we needed to tighten the counters on this bridge, we made our machine. I was fortunate enough to have a foreman in El Paso who took my ideas, added some of his own and fabricated a safe and useful piece of equipment which you will see in the video.

The last week that they were using the machine, one of the men mentioned that he had a video camera in the trunk of his car so I filmed an area of the bridge on the spur of the moment. The lack of experience with a camera and the fact that all action and narration was unrehearsed will be evident in the video. We edited the video so it will have some jumps in it. I must also mention that we did this work three years ago so we were wearing safety belts instead of the full-body harnesses that we use today. Believe it or not, the handsome rascals you are about to see are real Southern Pacific bridgemen and not Hollywood actors. (Laughter)

(Whereupon there was a video presentation)

Mr. O'Neal: Are there any questions? I am sorry for the quality of the video. Like I said, we were amateurs at it, but I think it shows what we are trying to do.

Member: Did you have any trouble with stripped threads?

Mr. O'Neal: No, sir. None of them stripped. We had one bar that we just could not turn. We had to flame shrink it. Like I said, the bridge was made up of three trusses. The two outside trusses were built in 1902 and it was interesting that when we turned the turnbuckles on that we also tightened up the I-bars on the other side. In the center truss, turning the turnbuckles didn't do much for tightening up the regular I-bars and we had to shrink them. In fact, after we shrunk them, we had to loosen some of the counters because it worked kind of backwards. Anybody else?

Member: Did you ever have to apply heat to the turnbuckle?

Mr. O'Neal: No. We tried that but we weren't too successful at it. We did it with a hammer sometimes. After we put the pressure on it, we would tap it with a 4-pound maul. We cleaned the threads and everything, but in retrospect, I don't think that did a lot of good. I think if I were to ever do it again I would just put the machine on and start turning them. It took a lot of time and I don't think the amount of cleaning we did on one thread had that much to do with anything.

I appreciate all of you staying through lunch to see this presentation. Thank you very much. (Applause)

Mr. Steele: Thank you very much, Del. Next I would like to have our standing committee report. Our standing committees consist of equipment, material, and education. This year we are going to discuss education. I would like to have Bill Nelson come forward and give us a little talk on this, please.

STANDING COMMITTEE REPORT

W. H. Nelson

Education Committee Chairman

Thank you, Don. Earlier, Paul talked about the classes we have been conducting with quite a bit of success. We have had some excellent instructors and I would like to compliment them. They have done a very fine job.

In 1992, we started doing two bridge inspection classes a year. We did one in Pittsburgh and one in Denver. Our intent is to scatter these classes all over the country and make them a little more accessible. Those classes met with great success and, again, it is attributable to the quality of the instructors we have doing these programs.

In 1993, our bridge inspection classes were in Atlanta and again in Denver. Once again, this met with very good success. We have had a lot of requests from the attendees to follow up with a program that would address repairs of defects found on bridge inspections. We are going in that direction, but first we will be doing a bridge inspection class again here in Denver.

We are developing a program with a three-day remedial action or bridge repair type program that will be based on what was found on inspection and now what do you do with it. We have had a lot of questions asked of us about that. A defect is found and now how do we repair it? I know a lot of shortlines send people who need some basic information in this regard. Tentative dates for that seminar are November 7, 8, and 9, 1994.

The Sheraton Denver Tech Center is an excellent facility for presenting programs and housing people. The dates are April 17th through April 20th at the Sheraton Denver Tech Center. All members of the B&B Association will be getting a notice on it. Notices will also appear in the trade magazines. We have geared these classes to be primarily for railroad employees. However, attendees have also included contractors, some consultants, and some design firms who have not been in railroad engineering as such and are interested in what we are talking about.

Class size is limited to 40 people. As I said, the class is designed primarily for railroad people and we try to hone their skills. We have the same instructors committed to do the classes in 1994, Don Sorgenfrei from Modjeski and Masters, Don McCammon from HNTB here in Denver, Dave Franz from Kansas City Southern, and Joe Lileikis from the Union Pacific Railroad. So we have good continuity. These fellows have done four classes now and they will be starting on the fifth bridge inspection class.

On the first day, we intend to address computerized structure management systems, bridge inspection reporting systems, fundamentals of bridge inspection, and underwater inspection. Then we will get into bridge components and elements, bridge mechanics, waterway drain, and piers.

Generally when we get into the timber on the second day, we talk about critical problem areas of timber structures, some ways of upgrading and extending the life of timber structures and then inspection and evaluation of timber bridge structures.

Concrete will be presented pretty much on that second day also. It tends to deal with material, mechanics, deterioration, and inspection of concrete structures.

The steel portion will take care of the second day and part of the third day. We'll start out with steel bridge material, talking about the different types of steel found on existing bridges. We'll also get into inspection and evaluation of those.

We have a movable bridge section. We'll talk about both structural and mechanical

portions of movable bridges. We'll also look at inspection and evaluation of bridge bearings.

On the last day, we'll get into emergency inspections, culverts, tunnels, a little bit on protective systems, and some special bridges.

Tuition for the classes will be \$375 for members, \$475 for nonmembers.

I would like to invite you to send some of your people to these classes. It will be very beneficial and with the Federal regulatory agencies looking more and more towards what the railroad industry is doing with their bridges, I think it behooves all of us to make sure our people have their skills honed and that they can do an excellent job for you. Thank you. (Applause)

President Saletnik: I have the latest statistics on registration as of 11:30. The current conference registration is 2,209. With the spouses and significant others, we have a total of 2,718. That's a pretty successful conference so far.

Before we adjourn, I'd like to remind you that we also have our special subject sheets located on the table just outside the door. In order for these special subject presentations to be a success, we need your participation. Please take one, fill it out, and drop it off at the registration desk.

There being no further business, I hereby declare this session adjourned.

Adjourned.

JOINT SESSION

Wednesday, September 22

President Welch: A few comments about our attendance for the week. The last number that I had was 2,216 railroaders and 508 spouses. I think that is a record total attendance at least as far back as Atlanta. Atlanta beat us on railroaders but we have more ladies with us this week. Attendance has been fantastic and we certainly appreciate that.

Secondly, we have been talking about committees for next year and there are cards on the back table. We would ask that you railroaders get your committee cards and sign up for next year's program in Chicago. Your involvement is very much appreciated.

The other item is we have some surveys. We would very much like for you to fill them out on each of the presentations that you have seen during the week. We use the feedback to plan for upcoming programs.

Just as a matter of industry information for those of you who haven't heard, there was a very bad Amtrak derailment last night in Mobile, Alabama. We don't know much about it except that there were two locomotives that apparently caught fire. At least two cars are in the water; a baggage car and one coach car. We have had heard varying numbers of missing people and fatalities. I think it would probably be worthy of us to take a moment of silence for the families where there were fatalities. If you will, please. Thank you.

With that, I don't want to get started out like I did yesterday behind schedule so this morning I want to introduce Dr. John Samuels.

John is currently vice-president of engineering for Conrail. He was appointed to this position in March, 1992. Prior to 1992, he held the position of vice-president of continuous quality improvement and prior positions of assistant vice-president of engineering and design, assistant vice-president industrial engineering, and director of industrial engineering.

Before coming to railroad service, Dr. Samuels served as associate professor of industrial engineering at Pennsylvania State University and a manufacturing engineer with General Motors. Dr. Samuels holds a Bachelors degree in industrial engineering from General Motors Institute and a Master's of Science and a Ph.D. in industrial engineering from Penn State. He was named a Penn State outstanding engineering alumnus in 1993. Please join me in welcoming Dr. John Samuels. (Applause)

KEYNOTE ADDRESS

TECHNOLOGY AND QUALITY ISSUES FACING MAINTENANCE OF WAY IN THE 21ST CENTURY

Dr. John Samuels

**Vice-President Engineering
Conrail**

Good morning, everybody. Everybody who is part of an organization that has a quality process in place, raise your right hand. Now everybody who has a customer survey that is issued at least on an annual basis to understand your customers, raise your left hand. Now everybody look around for a second.

I would venture to say that five years ago you probably wouldn't have seen 10 or 12 hands in the whole audience. So life is changing. As we move towards the 21st century, I think we are going to find that life is going to change even more rapidly. You know the old cliché that change is here and it's a permanent thing.

I would like to talk about our view at Conrail of what is going to happen as we transition into the 21st century. I have asked Reuven Shiloh to do a little chart work for me. I would like to direct my comments as much as possible to the Roadmasters organization because that is a front line organization in all that we have. They are really on the firing line and they need all our support. Therefore I'm going to focus my comments to the roadmasters in the audience. They are good comments for all of us, of course.

You notice this says, "Issues Facing Us in the 21st Century." It doesn't say answers. See, I'm not dumb. I'm not going to stand here and say that I have the answers to these issues. But I will try to go over some of the very critical issues that I think face our industry and particularly face our maintenance-of-way department.

As I do this, I'm going to be referring to Conrail's network and you see it there. It's a 20,000 mile network. As you know, Conrail was formed in 1976. At that time, we had 36,000 miles. Now, we have 20,000 miles. So over our approximate 16-year history, we have been reducing track 1,000 miles a year and I will tell you that this is going to continue this year and it will probably continue for the near future as we move towards the year 2000.

The reason for that will become clear as I go through the rest of the presentation. I would like to talk about issue number one. This is a plot of Conrail's assets as a percent of total assets. Conrail has \$7.1 billion worth of assets and that is a 1991 figure. I will tell you the only reason I didn't change this slide is because the 1992 figure, and going into 1993, is about the same. Sixty-eight per cent of those assets, and this is not unlike your railroads also or maybe your industries, is in the roadway department. It's in the right-of-way.

Issue number one to all of us, and it's a vital issue that the roadmasters can help us out with, is can railroads achieve a return on funded assets greater than their cost to capital? The reason I bring that issue up is, that if you are an accountant you know that it is not worthy of putting money into the physical plant unless the return you get on that is greater than the return you could have gotten somewhere else. You don't put money in the physical plant unless it has an attractive return.

In this particular case it, at least, has to return our cost of capital. So that is issue number one. Since the physical plant is such a big part of the assets of railroads, we have a challenge in front of us for that issue.

Now, at Conrail, like many other railroads and almost all now, we have a quality process and that quality process says that we want to have consistent conformance to customer expectations. Now, to those individuals at Conrail, what that means as a company is that we want to be a seamless transportation carrier.

Now seamless is a interesting word. It is a very user friendly word. All it means is that the railroads in the United States are just seamless particularly in North America and that various lading flows from railroad to railroad and it is transparent to the customer what road it is on. Also, that all railroads are using the quality process to achieve the seamless service.

So with that, we have a second issue. The second issue is that the truckers in the United States now perform anywhere from 93 to 95 per cent on time. So issue number two for us is, can we provide on-time performance of at least 95 per cent dock to dock in railroading. That is just not one railroad. That's origin to destination no matter where the origin is, and no matter where the destination is. Because if you don't match or, in fact, exceed your competition, you are always going to be second best.

So an issue facing us today, and particularly I will get into how the roadmasters play into this one, is can we achieve that kind of service.

Now issue number three that is facing us, and by the way, these issues are facing all of us because the reality of the marketplace is that if we don't achieve some of these things, there are going to be a lot of us in this room who will be gainfully employed in other industries by the year 2000.

This is a chart that shows railroads as the blue line, the market share is gold and this is the market share lost to trucks. The truckers' revenues are shown in red. It doesn't take a rocket scientist to understand that the red line is far out achieving the blue line. As a matter of fact, the railroad industry is sort of stuck in a rut between about a \$27 and \$30 billion a year business. Truckers, I hear, are up around \$185 billion.

This gives us our third issue. Can railroads grow their revenue margin; that is what you make on it after you pay your bills, and have growth in earnings per share for stockholders. Some railroads are doing a very good job of this. Others aren't, but the challenge is that if we are all going to be seamless, we all have to be healthy. So I'm really not talking about Conrail here. I'm really talking about the railroad industry in general in North America.

Now, at Conrail we have coined a word and here is our view of what we have to do to allow our transportation department and our marketing department to both sell the service that is required, market it properly and earn the income that the corporation needs. In engineering we have to create what we call a transparent physical plant. Now, some employees feel that this is another way of saying, "Oh, my God, they're going to go from 20,000 miles down to zero." We would have a tough time running the trains if we did that.

The fact is what we mean by this is that we want to create a transparent physical plant in that it works every time. It doesn't get in the way of transportation. The transportation department can just run the train set and they don't have to worry about the tracks or the signal or the bridges.

So we want to create a transparent physical plant. Therefore, the next issue that we want to talk about is can the engineering departments in railroads create a cost-effective transparent physical plant? You notice I slipped you a big one in here. I said a cost-effective transparent physical plant. Because what we will see later is, you can buy your way into a great physical plant, and for anybody that was out looking at the equipment, well, you know that the equipment is available. Of course there are a lot of people looking for work in North America. It is not a case of not having men, materials, and machines. It's a case of being able to afford the appropriate balance of men, materials, and machines.

So one of the great challenges to the engineering department between now and the year 2000 is how do we provide a cost-effective transparent physical plant. I'm going to show data that we have at Conrail which shows how we are doing that.

But before I show you that data, let me get a little academic. This chart is very busy so let me explain it to you. I want to aim this chart at the roadmasters now. No matter where you are in any company, you can use this chart. This chart says simply that in the 1950s and 1960s, a lot of us were practicing what we called quality control. We measured parts by doing acceptance sampling.

So the life cycle of problem solving of continuous improvement of the application of the principles of quality in the 1950s and 1960s was that a problem showed up and you implemented some solution. You gathered some data and you evaluated it. If it didn't work, you went back and started over again. You were in this yellow area right here.

Now there are two levels on this chart. There is a level of thought which is thinking processes and there is a level of experience which is data collection. The problem-solving process ricochets back and forth between those two states. Now, in the 1970s and 1980s, what we did was we started what we called reactive problem solving and that is the basis of a lot of quality processes that you have now. In engineering we called it the scientific method or the methods engineering approach. In that, you identify problems.

You got a little more proactive there. You identified problems before they became serious. You analyzed them. You gathered some data. You did a cause and affect analysis; you found a solution; you implemented the solution; and you gathered some data and evaluated it and if didn't quite work well, you went back and started over again.

Now the key to the year 2000 in my mind is the blue part of this problem-solving diagram. The blue part says that if we are going to solve problems and we are going to do the right things right, we are not just going to solve problems that are meaningless to our companies. The solutions might be nice, but they might not make any money for us.

What we have to do is we have to get a feel for the customer. We have to understand the customer. I will tell you I was really excited when I went out and saw the equipment because most of you folks who were out there showing that equipment started asking questions like is this what you want? How could we modify to better suit your needs?

That's being customer driven. So I say to the roadmasters in the audience, one of the first things that you have to do when you start initiating action for continuous improvement is you have to get to your customers. It could be a local trainmaster, or it could be somebody from the bridge department. Find out what their expectations are and what their problems are. Learn how to be customer driven. We could all practice more on the headend of understanding the customer.

Now let me talk about understanding the customer here in terms of some facts. In the engineering department at Conrail, we have what we call peak performance goals. We have learned in our quality process that the measure and display is very important. You have to establish cross functionally what set of goals will help you achieve the desired customer satisfaction that you have surveyed and found. So in engineering what we have done is we have looked at these as our primary goals for 1993.

I tell you these are sort of never-ending things. They will be goals in 1994 and 1995 and they will be goals until such time as we achieve a transparent physical plant.

Now, you will notice here that a lot of these are generic to our industry: safety frequency, false proceeds in the signal department, minimizing the number of derailments, minimizing the FRA defects that you find, minimizing train delays, and minimizing slow order miles.

When we tell you it's a transparent physical plant, we are saying that these are the things you tackle: hot box detectors and false stops. How do you make sure every time you stop a train, which is a nuisance as far as the transportation department is concerned, that it is in fact a good hit and you do find a hot bearing?

Regarding work train performance, transportation supplies us with work trains. Do they do a good job? Well, we have to gather some data and give them a report card because in this particular case, they are our supplier. Our DATS production is our Discretionary Track program at Conrail. It is our tie, surfacing, and rail production. Look at the productivity of that. Operating ratio performance, and then some car turnarounds, lubrication of the rail and asset utilization. Those are some of our goals.

Let me give you some particulars on some of these, but before I do that, however, let me give you issue number five. Conrail's engineering department has what I call a cascading communication process. Starting over on the left-hand side, after the quarterly results of the corporation come out, I hold a town meeting with about 100 people. The division engineers attend that meeting along with some of their staff and at that meeting we go over safety and corporate results and how are we doing with regards to departmental goals and all these things that are critical to us and critical to the success of creating a transparent railroad.

Subdepartment heads, and in this particular case let's say a division engineer, then takes back to his division what I said in this meeting. He then creates a structure of town meetings with his people, i.e. middle management, that deals 50 per cent of what I said in terms of corporate health and 50 per cent with local issues, putting what the corporation's circumstances are in terms of a local contest.

That, then, is cascaded to roadmasters or line managers, if you will. In that particular instance, they only talk about 25 per cent of what I said, 25 per cent about subdepartmental issues, maybe local and divisional issues, and then 50 per cent on local issues that the roadmasters have and the issues he has to communicate to his people.

This is what I call a cascading communication process because in this process you will notice the feedback arrows. The feedback comes up on survey forms. This process is meant to do one thing, folks, and that is to put the market realities of what railroads face in the hands of our employees spoken in the words of our management, from top to bottom. So everybody gets the same story about how we are doing and what we face as challenges.

This issue then is an issue that says roadmasters must be a vital link with communicating the realities of the marketplace. Everyone has to learn how to be very articulate about what we face as an industry. Our employees must understand what the market realities of railroading are in this day and age.

We can only mold the future to the year 2000 if our employees understand the consequence of what we are doing.

Now, let's take some of the information that could be transmitted in this type of meeting. At Conrail we keep track of road freight train delays. The transportation department does it. They are my customer. They give me a report card weekly.

This pie chart that you see is year-to-date through September 11, road freight train delays. Now they average 10,000 hours a week for road freight train delays. You might think that is a lot, but compare it to yours. Let's see what your folks say. In this chart, I want to just bring up a couple quick points. Number one is the green pie that is sticking out which is the amount of delays caused by the maintenance-of-way department, three per cent.

The blue pie at the top sticking out is the number of delays caused to road freight trains by the C&S department. Now, this is not rocket science, so let me ask you a question. If I say to you what department seems to be the least of the railroad's worries based on this pie chart, what would you say? The engineering department.

If you all go back to your corporations and you look at the problems that the corporation has, you will find, in general, that the engineering department is the least of our railroad corporation's worries particularly in terms of these delays.

Now, 51 per cent is the transportation department. Let me just give you a flavor of what this means. It means meet/pass delays. It means not getting the crew and the locomotives on the train to get out of the yard on time. It means when you go over the road and have

meet/pass conflicts that those meet/pass conflicts aren't resolved in an efficient manner. It means that when you hit somebody at a road crossing, you get delayed.

There are a lot of things that you have to work on here. Notice the 15 per cent in the yellow for foreign railroads. That is the amount of delay we incur because at interchange the train doesn't get there when it is supposed to get there. So we have to delay other things.

If you take a look at this pie chart and sort of burn it into your mind, creating a transparent railroad from an engineering department's standpoint means taking that three per cent slice and that one per cent slice and going to zero with them.

Just so you don't think we don't track this, for the week ending September 11, the maintenance-of-way department train delays were basically scheduled on the maintenance-of-way work. Anytime we interfere with the railroad, and it doesn't matter whether it is production work or track inspection or what not, that's reported.

Maintenance-of-way scheduled work is the largest part of the chart, then slow orders, then track obstructions, then switch inoperable, then broken rail, and then bridge up.

But these are, in fact, on the chart, both on an accumulative basis. The green is for the current week and the blue is year to date. If you are a roadmaster and you want to know what to practice continuous quality improvement on, practice it on this chart. That's what you practice it on. Now, if you track that over time, you will notice something interesting. The green line is the total number of hours per week of C&S delay.

You will also notice a couple of things. Number one, it is rather consistent at 100 hours and number two is, that the variations are rather minor. So it is what Deming would call "statistically under control."

The blue line is the maintenance-of-way delays per week and you will notice that in the winter time, in January or February, because this chart goes all the way back, you will notice that maintenance of way is about 200 and then it pops up to around 300 or 400. That's when the production season starts. Those two big blips on there, that is when you try to do work on a single track railroad, high density railroad, where the transportation wants to run the train set at about the same time you want to do the track work. What happens then? You get into a fight. You know who wins? What does that chart show you? It's debatable who wins.

Now, I thought this was very appropriate yesterday when Jerry Cartwright from CSXT said that the track geometry car, once thought to be the dilemma of the roadmaster, is now the roadmasters' friend. Conrail, of course, has a track geometry car consist which we run around the railroad. We put on about 45,000 miles a year. We plot as part of our process, FRA defects per thousand miles tested. We had maybe 110 per 1,000 miles. That's about .11. In other words, we find about one defect every ten miles.

You notice it has come down significantly over the years. The miles tested is up around 45,000 plus. Of course, this year it is only up to 830 and we have had an increase in the number of defects detected because we have put new instrumentation on the car to look at the profiles. For the first year we are getting serious about profiles and the consequence of that is we are suffering more defects.

This brings up the next issue which I call issue number six. A roadmaster must have at their fingertips all the pertinent data that they need to manage their territory. It must be user friendly. We heard how the track geometry car worked and it was user friendly, but it must be user friendly. It is important that a roadmaster have the historic data at their fingertips.

At Conrail, we started a GIS system, or Geographic Information System. We started to log all pertinent data into a geographic information data base and then we were going to develop mathematical models, predicted models, for rail replacement, surfacing work and tie replacement. That will be at the fingertips of the roadmaster. He will have a PC that he can log right into and get all that data at a time.

If you do look at profiles, and there are some people debating this, if we look at a profile that means we are really going to have some defects and, yes, we are. But what you are doing

is you are creating the ultimate good from a track standpoint. The smooth ride that is smoother than the highways.

Conrail did a comparison for coil steel shipments and what we found was that actually coil steel on Conrail rides smoother than it does on the trucks on the highways both in the longitudinal, latitudinal, and vertical forces. The orange bars are the forces on the railroad and the green bars are the forces in trucks in the same origin/destination pair with normal trucks and then with the air suspension systems in the trucks.

Issue number seven is that the railroads must be significantly smoother than the highway in the future, and the reason for that is we have to cause significantly less damage to the lading than the trucks. One of the very valuable attributes that we can contribute in the maintenance-of-way department is those geometry car runs that show zero defects. That is a smooth railroad and that is what we need.

You also have to be cost effective and this is issue number eight. Engineering departments must help their companies become the low cost provider of engineering service. Each year I have our financial department take the R1 reports for every Class I railroad and give me the engineering dollars spent by those railroads.

As you can see from here, I try to be very unbiased as I don't want to get into an argument. However, Conrail spends about \$36,618 per track mile; \$22,000 plus of that is spent on basic maintenance, \$14,000 is spent on capitalized maintenance; i.e. ties, surfacing and rail done by production gangs.

You notice the industry average is \$38,000 per track mile and you can see the split between capital and expense. If you look at the other major Class I railroads, which I monitor annually in terms of all their costs, you will find some great anomalies. Railroad number four on the very right of this chart is the low-cost provider of engineering services right now this year. They are at \$31,000. Then you have the high-cost provider which is railroad number one at \$44,000.

What that means is if you take the different structures of all the railroads, there are some railroads that are spending about \$200 million a year more. This guy is probably spending a couple hundred million dollars more on the rights-of-way than this fellow here. Which one is right? Who knows.

The fact of the matter is we all have to work together to shrink these because in time we must make our corporation a low-cost provider of transportation services.

Issue number nine is: we must become injury free. On safety, the roadmasters must educate their employees and work with them to have the railroad become an injury-free work place.

This chart is for the June statistics that I guess are the latest statistics that have come out of the FRA. Conrail has a frequency rate of 5.81 as you see and then across the board we have Norfolk Southern here and Burlington Northern here.

I put these numbers on here because they are issued by the FRA. They are not my numbers. It is just for the month of June. There stands the range of our frequency rate for lost time accidents and I think we all have to work with one another to get down in this range right here.

Finally, issue number ten is: roadmasters must achieve break-through thinking. We must invest education in our roadmasters so they, at the ground level, start using break-through thinking concepts. Here is one concept. This concept is a lubrication concept.

Conrail has six tripometers that measure coefficients of friction on the gauge surface of the rail. We have a concerted program to take the coefficient of friction on a gauge surface of our rail down to .2. That is based on the research that we did in conjunction with the AAR at Pueblo. The red line is where we want everybody to be after two months of starting their lubrication teams on their divisions. Then the blue line is after four months and the green line is after six months. What we are trying to do is take each division and have them measure

their mainlines and high tonnage secondary tracks and bring the coefficient of friction to .2.

Let me tell you what this gets you. In the spring of this year, we had a week long business car trip where we rode around the railroad. During that trip, I invited the lubrication maintainers, the fellows who fill the grease buckets, to come on the train with us and tell us how they are doing. We have invested in our lubrication maintainers, our wayside maintenance people, and their supervisors the challenge of getting to a .2 coefficient of friction.

I tell you, talk about a bunch of people getting excited about something. What they did was actually come on board our business car trains, sit down next to me, open up their three-ring binders and explain to me how they surveyed various types of equipment, how they work with the grease manufacturers, how they look at the locomotive amount of lubrication, and how they monitor their systems.

The coefficient of friction has given the lubrication maintainers a number to shoot at and some science behind what they are doing. It has really worked out well.

The roadmasters must use that kind of thinking, the thinking of measure and display, to enlist their employees in reducing the costs of railroading.

Backing that up, of course, is a big educational program at Conrail. We have continuous quality improvement training. This is by division. The red bar is awareness training of quality. The other bars are skills in communication, problem solving, and data collection and display, and best business practices. There are various two-day courses you can take. Our employees are now taking these courses so that they understand what quality means and how to use quality to solve problems.

I guess I will summarize then by saying this: We are trying to create at Conrail a situation where Quality Begins With Me. Then if you all read that chart just as it is written, the fact of the matter is, it begins with you, too. It begins with all of us. The environment we are trying to create, from roadmasters on up, every employee on up, is that we have to think about quality. We have to take these issue that Reuven has put down over here and we have to all practice those against that set of issues.

Let me go over them one more time so you know. One is that we as an industry have to get a return on funded assets that is greater than our cost of capital. On the railroad industry, the cost on capital is about 11 per cent. It doesn't vary very much from one railroad to another. You need to get a return on assets over 11 per cent.

We need to achieve an on-time performance of 95 per cent. We need to help our transportation departments. Engineering must help the transportation department do that, they can't do it by themselves. We have to create this transparent physical plant.

We have to grow our revenue margin and earnings per share and what that means is we in the engineering department contribute by providing the low cost railroad infrastructure. Maximum quality and low cost. Not just low cost, but maximum quality, and transparent.

We have to achieve a cost-effective transparent physical plant where the physical plant on a railroad just works every time and it is not a nuisance to the transportation department.

Roadmasters are the vital link. They have to communicate to the employees the reality of our marketplace. Some do; most don't right now because we haven't given them the information to do that or the skills and communication to do that.

Roadmasters must have all the historic engineering data about their territory at their fingertips. This includes GIS, PC, and planning models. The railroads must be significantly smoother than the highway in order to make our railroads the carrier of choice.

Engineering departments must help the railroads be the low cost provider of transportation service. Roadmasters must understand their employees and strive for a safe workplace.

Finally, the roadmasters must achieve breakthrough thinking as part of their daily work.

I guess when I sat down and tried to put these issues together and tried to put them together from what some of our roadmasters have told me, that is in essence what I think needs to happen between now and the year 2000.

Thank you very much. (Applause)

President Welch: Thank you, Dr. Samuels. That was excellent.

At this time I would like to turn the podium over to Darrell Cantrell who will introduce our next speaker.

Mr. Cantrell: Good morning. I definitely want to thank everyone for coming out this morning.

Concerning the next issue, if we took a poll in here and probably on most railroads today, most of us would average 20 years of service. In those 20 years of service as an average, we as track fixers have most likely seen a lot of issues come about such as triple-axle locomotives. We never thought we would ever overcome that. Then came along the 100-ton coal car and we thought we would have to rebuild the railroads.

Then just when we think we have our track where the we need it, we have another issue arise. I think this next presentation is something that faces every one of us in this room. This fear comes about us every day and that fear is of the wonderful double stack and rail turnover.

I think we are very fortunate today to have with us Bob Cartwright, director of research and development for Union Pacific in Omaha. Bob got his Bachelor of Science degree from Oregon State University and his MBA from the University of Nebraska. I enjoy going into Lincoln and seeing that big N on the stadium. I guess that means the house of knowledge. I couldn't figure out anything else. (Laughter)

I live in Kansas City and Fort Worth and when you live in the Midwest, a lot of our main blood comes out of Nebraska just as the Union Pacific does and you get sort of tired hearing about the Nebraska football team. (Laughter)

Nevertheless, Bob, like I said, has chaired the double-stack task force over the last two years. I wish that each one of us in this room as track fixers would have had an opportunity to sit in on one of those and the issues and pains that they struggled with in this task force.

At this time I would like to introduce Bob Cartwright. I think he has a very wonderful presentation on double-stack related rail turnover derailments. Bob. (Applause)

DOUBLE-STACK RELATED RAIL TURNOVER DERAILMENTS

Robert Cartwright

**Director Research and Planning
Union Pacific**

I am really honored to be invited to come here. It isn't very often, but once in a while we come upon a project that is really a potential disaster. Then we come out learning a lot about it.

This is where it all starts. This is where we were about five years ago scratching our heads and wondering why this happened. If you look at that, you will notice the low rail turned over, the high rail turned over and cars are up on their sides and we are in trouble.

To give you a historical perspective, in 1988 we had five derailments, three of them on the Santa Fe and two of them on our railroad at the Union Pacific. They were characterized by low rail rollover and three to six degree curves on 125-ton cars.

In the first five, we identified several common factors and this is well before DDTF. We

were just kind of struggling along here. We found that they were on continuous welded rail, cut spikes, and wood ties. They were on low mileage cars which meant that they were not worn out. There were low draw bar forces. The cars were not heavily loaded. The train was running below balance speed and the male connector was leading.

In the earlier theories, we thought that it was heavy cars which we eventually found it wasn't. We thought maybe it was streamlining problems and we thought the articulating connector was binding. That just gives you an idea of where theories go because as it turns out, none of those were correct.

One of the things that led us to the articulating connector was all the metal flow that was occurring in there. It just seemed like that was probably where the problem was. These cars were different and they had this new articulating connector and we just right away thought the problem was there.

As a consequence, in early 1988 we started lubricating connectors, the center plates, and the side bearings and it seemed to solve the problem.

Of course, this was in October and we went along for almost a year before the next problem occurred. We also did some early testing in October with the Stockton culprit car. We tested at the Transportation Test Center. There were several participants including APL, Santa Fe, ASF, Rail Sciences Trailer Training, and all of us in the Transportation Test Center.

The test results indicated that the connector wedge position had no affect, lubricating the connector had no affect, and lubricating the side bearings and center plates reduced the turning movement. Now we were starting to find out something.

Removing a male side bearing had no affect and removing the female side bearing at the center plate lube decreased the turning movement.

Our conclusions were that we were involved with high truck turning movements and we also found that lubricating the high rail seemed to be a factor, but we couldn't seem to figure out why when it was only 125-ton cars. We had been running 100-ton cars over this same rail for a substantial amount of time and just hadn't had any problem at all.

Then in February, 1990, Trailer Train, or TTX, on Santa Fe did some testing at Cajon Pass. They tested dry and lubricated side bearings, dry and lubricated center plates and connectors, and dry and lubricated track, some new side bearing designs and new wheel bearing profiles.

For you that participated in this, you might recognize this slide. The conclusions or results were that the dry center plate created the highest turning movements. Lubricating the side bearings had little effect on the turning movements which was a new piece of information. We also found that when I lubricated the high rail, it increased the L over V. The new AAR 1B profile also reduced the L over V, but we were still concerned about why it was only on 125-ton cars.

Just to give you a perspective of where we are with these cars, the 125-ton double-stack cars derail at a rate of about one-third of the rest of the national fleet on a ton mile basis, which means that it really has a pretty good performance except that when they do derail, they have all similar characteristics which really gives you the impression that you could go in with an engineering solution to figure out what is going on and solve it.

Also the 125-ton double-stack car is very dynamically stable. It gives a very good ride.

Well, in the summer and fall of 1990, we had five more derailments and that really got our attention. We started to work on how we were going to get through this. The Union Pacific, Burlington Northern, Santa Fe and Rail Sciences met in October, 1990, and we decided we were going to go after this problem to figure out what it was. At that time we invited a lot of other people to participate and it was almost like a bandwagon. People just started jumping on it. We wound up with a lot of people who participated in this thing.

The first meeting was in November. There were 14 initial members. Eventually we had 16 paying members. The objectives were that we agreed to a systems approach which

meant we would perform testing, determine the causes of the derailments, and make recommendations.

This is a list of the group that were in this. It really was a good effort to investigate this issue.

One of things that we did early on is that we had some limitations. First off, we were not a sanctioned group of any kind. We couldn't promulgate standards or regulations. We wouldn't recommend specific components and we initially agreed to hold all the research proprietary mostly because of the suppliers that were involved in there. They wanted to use that to develop some products.

One of the things with our systems approach is we decided that we were going to go after this thing. We investigated car body torsional stiffness, the container stiffness, and connector characteristics. We looked at the side bearings characteristics, truck turning movements, and truck geometry. We looked at truck work characteristics, and we looked at center plate lubrication. We eventually went down and looked at the rail and rail fasteners. We looked at rail lubrication. We looked at the track gauge and rail profile.

From all the derailments that we had up until that point, we started developing a data base which involved location, the railroad, the date, and the curve track data. We gathered data on the cars, the trucks, and the operating characteristics at that time in trying to identify common characteristics.

This is a busy chart that has a summary of all of those derailments. By the way, there were 22 of them between 1988 and when we closed out in fall, 1992.

When starting to look at the common characteristics, you can see that geographical location puts most of them in the West and we were really at a loss to figure out why that was. We had one member from Norfolk Southern say, "Well, we must have a magic river at the Mississippi. If you go east of there, nothing happens." It was just looking that way at that time.

Some other characteristics were the time of year. If you look at this, you really notice that July, August, September, and October is where they occurred. They occur in the other months, but in general, it is in the late summer and early fall.

When you look at the degree of curvature, we have some out at around one degree, but most of them lie between three and seven degrees of curvature. That was probably a significant factor.

We looked at balance speed which goes back to super elevation and we have some out here. We have one right at balance speed. There are some out here at two to five miles an hour over balance speed, but the large number of them are around 10 to 15 miles an hour under balance speed. There is a two or three mile an hour under balance speed there.

We looked at the connector orientation and that pointed out something that we didn't really understand before. That is the predominant one of these is what we call leading truck. What that really means is that the center plate is on the front of the platform. The way these cars are set up, if you are going one direction you of course have the leading truck which is the first truck. Then you can have four more leading trucks, or if you turn the car around, you have one leading truck and five trailing trucks. So orientation of the car makes a difference in this case.

Anyway, from all of that, we started summarizing the things and we found that low rail rollover was an issue, dry weather seemed to be an issue, and moderate curvature was an issue. There were always cut spikes, fasteners, and wood ties. We were usually running under balance speed. The car weight didn't seem to be a factor. The male end was leading, and a new one that popped up was that all of the 125-ton cars were VIP trucks, which is different than the 100-ton.

We came up with a theory that essentially we thought that the increase in the lateral forces on low rail was being caused by loss of wheel set steering, high truck turning

movement, warping of the truck, and once that happened, if you had insufficient low rail rollover resistance, the rail would go.

We then started on a program of testing and modeling. We investigated truck movement, truck warp, side bearing characterizations, rail deflection, rail rollover modeling, and truck tear downs. We looked at the geometric differences between 100 and 125-ton trucks. We looked at car body torsional stiffness and center plate lubrication. We had some significant changes to the new car model and breakthroughs actually in the center plate modeling area. John Elkins from the Transportation Test Center did that work and it was outstanding.

Next was the wayside testing at Cajon Pass and curving performance testing at the Transportation Test Center. This shows some of the testing. This is an air bearing cable at the Transportation Test Center. This device down here is a table that is floating on a cushion of air and you attach the truck to that and then you can twist that or yaw that truck on a relatively low friction base and then measure the forces that it takes to yaw that truck with different configurations of center plate, center plate lube, and side bearing, et cetera, with different torsional angularities on the car body.

What we did there was characterize the truck turning movements which we really couldn't do in the field. At ASF, we did truck warp testing. Here is some of the instrumentation. Here are some of the actuators that were used to test for truck warp. We investigated with and without the VIP pad at the bearing adaptor. During that time, we also characterized worn trucks, new trucks, and various designs of 100 and 125-ton trucks.

We took all of the known side bearing designs and some new experimental ones and characterized those during a week of testing of several 14-hour days. Gary Wolf from Rail Sciences and all of those people really worked hard to fix this.

This is a picture of their testing device for the friction on the side bearings.

The output of the task force was six reports of which the final report now lies with the AAR and the mechanical people.

The significant test findings were that the dry center plates increases truck turning movements by 50 per cent. The VIP pads reduced 125-ton truck warp and friction by 50 per cent. The male end leading produced higher gauge spreading forces. Two-point contact on the high rail reduces truck steering movement. For you, that is really important because you lose your steering movement from that and you wind up with a problem with the warp trucks.

The articulating connector didn't have any affect that we could find.

When we talk about the steering movement, as you go around the curve and as the wheel set drifts to the outside, the effective diameter of the outside wheel gets larger and that's what really pulls the truck around the curve. If there is anything in this frictional area that destroys that steering force, you will wind up with a loss of steering movement.

One of the things is two-point gauge point, gauge corner grinding. If you do not grind at the correct profile and you wind up with this two-point contact, you lose that steering movement and the lead wheel on the high side begins to fall back.

The same thing can happen if you have lubrication on the top of the rail. If there is any lubrication really, that will reduce the coefficient of friction here and the lead wheel starts to drop back.

The turning movements are developed in a center plate. Almost all of it is developed here and there is a little bit in the side bearings. We found that on the male side, the tight side bearings actually helped you go around the curve. The tight side bearings on the female side of the curve inhibit it. Therefore you have to be careful when you get into double-stacks and looking at tight side bearings and which ones are tight and which ones are loose and whether they are a factor if you are having a problem.

But in any event, if you lose the steering movement and the turning movement is large enough at the center plate, then the truck bolster will not rotate forward on the high side. Then you will start to warp the truck.

Here are some pictures of what truck warping is. This one is the normal curving performance which is desirable. If you lose your steering movement on the high rail and you don't have enough warp resistance, then the truck will tend to assume this configuration here. When that happens, if you have a dry rail down here at the bottom, then the creep forces will be such that they will kick over this low rail.

Part of the reason for the warp resistance of the truck, and this particular 125-ton truck has a relatively low resistance, is because of this VIP. There is a program now to take those all out.

Here is the reason that the low rail rolls over. When you drift out and get flange contact on the high rail, you have a lateral force going horizontally with an overturn movement arm of about 7 inches to turn that over. You have a vertical force at the gauge corner holding down with a movement arm of about 4.5 inches or so there.

On the inside rail, once this has come out against the gauge corner, the inside rail has pulled away. The effect of that is to cause the contact point to move up on the ball of the rail to the point where now the vertical force is right here and it is down with a movement arm of only about two and five-eighths inches. You have lost all of your hold down movement because of geometry of the wheels on the rail.

Actually the overturn movement, the lateral force which is equal and opposite to the one that is on the other side, is on a movement arm that is seven and one-quarter inches. So it has moved up. What we have done when we lost a steering movement is we have caused the low rail to be the one that is most prone to roll over and that's what we see. It is the one that goes first. When that starts to roll over, if you have cut spikes, the first train through might not cause a problem but the spike comes up a little bit. The next train comes through and the spike comes up a little more. Eventually you are going to find you have a car and the track has deteriorated to the point a where that rail will roll over.

Here is a physical picture of what it looks like under the car. As you can see on the outside rail, the contact is at the gauge face right here. When you look at the other side, you can see daylight all the way up here until you get up on top of the rail. That's where the contact point is.

This is the issue of the articulated design where if you have an articulated car going in this direction with what we call the male end leading, that puts the center plate on the leading end of this platform and the leading end of that platform and likewise here and here. You wind up with one, two, three, four, five leading trucks. The reason that leading trucks are a problem is because of that turning movement.

If you have a trailing truck, the car body has already started through the curve and you wind up with the turning movements of the car body actually helping the truck come around. You can have this loss of steering movement on a leading or a trailing truck, but it happens a lot more often on leading trucks. The reason we don't have trouble with this on conventional cars is that every leading truck on a conventional car has a trailing truck right in front of it. That trailing truck is assuming the proper position and, as a consequence, it holds the rail down and the torsional stiffness of the rail doesn't allow it to turn over.

Now that doesn't mean we don't have problems there, but it is just infinitesimal. We have had coal trains go down with this very thing happening, but it is really rare. I only know of a couple and that's through years of service.

For it to happen on a coal train, you have to have the leading truck losing steering movement which happens frequently, but you also have to have the trailing truck right ahead of it to do that. Both of them doing it at the same time is really rare.

Anyway, as a part of our program we were able to come up with a very busy, complicated chart which really brings us all the way down to the rail roll over. Two-point contact is one thing. Either that or high rail lubrication. If the connector orientation is right, if the car container stiffness is right, if you have a dry center plate with tight side bearings and right

configuration, if the truck twist is under balance speed, you will lose the steering movement and you wind up with this high truck movement which then causes the truck to warp.

If at the same time you have a low warp restraint, it all comes together with the truck warping which starts to develop the high lateral forces on the rail. If you then have dry low rail, you wind up with a high rail roll movement which eventually works through the long track spacing with lots of hold down on the double-stack and you wind up all the way down here with everything wrong and a low rail rolled over.

That's very busy, but it is just to give you an idea of the interaction of all the things that can occur and why these things roll over. There is really no one reason. All the things have to add up.

Anyway, the conclusions were that on 125-ton double-stacks, we have to have simultaneous occurrence of five factors: the loss of a longitudinal steering movement; high lateral creep force on the head of the low rail; high truck turning movement; warping of the side frame and bolster; and insufficient low rail roll over.

Once you have all of these things, you are a cooked goose. It's going over. In the short-term, the DDTF made several recommendations and those were initiated very early on. One is to lubricate the center plate connectors, maintain the proper side bearing set-up height, remove the resilient adaptor pads, and avoid lube on side bearings on adaptor pads.

Initially we put lubrication on the side bearings because we thought there was a problem there with truck turning movements. Some people in the field put lubrication on adaptor pads for some reason. We have no idea why they did that, but they did it. It's the wrong thing to do.

We also recommend that you avoid the two-point contact on rail grinding patterns. I don't know how much trouble some of that will be, but that is imperative. If you have two-point contact and dry low rail with a double-stack, you are going to push the rail if the hold down isn't good enough.

You need to avoid differential track lubrication. What that really means is, if you have lubrication on the high rail, you are going to lose your steering movement. If you do lubricate the high rail for track wear issues, then you have to lubricate the low rail so that you can't develop the roll over forces from the friction coefficient.

We need to continue our educational programs for our mechanical and track people. This has started in mechanical. I'm not sure where we are with maintenance-of-way right now. We need to continue to evaluate improved side bearing designs, combinations, and applications.

In the long-term, we are developing techniques to increase warp resistance of 125-ton trucks. That is something that the truck manufacturers have to do. The people who are involved with that now have the data and they are starting in that direction. This means they are going to explore the new truck design.

We need to develop means to reduce truck and turning movements and there are people working on lubrications. We need to improve our low rail roll over resistance, which we see as imperative. We need to maintain the proper track gauge. I don't know if we mentioned that before, but track gauge is important. If the track gauge is too wide, that just makes that low rail roll over problem worse because what it does is it keeps pushing the contact point out farther and farther to the field side and causes that to be more prone to roll over.

In summary, this was a very successful project. This was one of the best efforts I have ever been involved in. I learned so much here that it is just unbelievable. I didn't have a clue on most of the stuff when we started through it.

We completed the task in two years and, considering the effort and the complexity, I thought that was very good. We finished it last November. There were a few details with publishing after that, but mostly it was done then. We have a lot of future technology transfer which is going to be applicable to all of the other cars.

The systems approach is very good. You need to look at all of the factors when you are looking at derailments and not just track or cars or operating practices or whatever it is.

We have a better understanding of the center plate, center bolt interaction and that is transferable to all cars. We are going to get new center plate lubricants and that is going to be transferable to all cars. We are going to get improved side bearing designs. Elimination of gauge corner grinding as an industry practice will do a lot for all of our cars.

We spurred research in the new truck design. We recommended elimination of differential lubrication and as that is implemented, it will have benefits for all of other traffic, also.

We gained an improved understanding of the truck turning movements. We now have an understanding of why maintenance of low rails and curves is important and we spurred advancement of the new car models.

In conclusion, in contrast to the first slide which showed those on the ground, this is the way we want to keep them.

Member: We have generally found that about a 1/2 inch relief not only gives us a lot more life out of the rail, but adds virtually nothing to the overturning. The best thing you can do with rail grinding to prevent the situation I have seen here is field side grinding on the low rail. That way, you can't ride over on that field side.

Mr. Cartwright: I know from the testing we have done that if you get two-point contact, you are in trouble. If you are grinding in a way and in such a manner that you don't get two points of contact, you won't have a problem.

Member: My name is Bob Blank with Norfolk Southern. We are one of the railroads that operate mostly east of the magical Mississippi, but even though we have suffered two derailments of a similar nature this summer and in previous years, we have had these rail roll over type derailments under coal traffic, coal cars. We did extensive testing this summer. We found, number one, concerning the grinding that the grinding profile we were achieving on the rail wherein we had a one and one-quarter to one and one-half inch contact patch on both rails, centered on both rails, resulted in the absolute worst situation as far as warping of the trucks and lateral forces.

We are now trying to shift that contact patch closer to the gauge side of the rails. The second thing we found on the coal cars and, I think, Bob, you mentioned that you have other wheels and that is trying to hold down the rail. But we were finding, in quite a few situations, where four axles in a row would be exhibiting very high lateral forces. That's enough force to just roll over the rail.

The other thing is the very dry lubrication conditions that we had or very high coefficient of friction. We are right now looking at the possibility of lubricating the running surface of the low rail. We found when we did this on the test, those forces just went away. We are exploring the possibility of trying to somehow implement that. It's going to be a little bit of a struggle because we have to balance that against traction for the following trains and so forth.

Mr. Cartwright: Thank you.

Mr. Cantrell: Thank you very much, Bob. I think he addressed one issue there. He said he never knew just exactly where the maintenance of way was in trying to do something about it. It sounded pretty good with the questions. I know that on the Burlington Northern and some other railroads we are running high rail lubrication trucks especially close behind grinders to help to reduce that friction.

We are doing something and it is interesting to note that we always rise to the occasion as maintenance-of-way and track fixers and I think we will rise to the occasion to accept a 125-ton double-stacks. We have to realize that the heavy axle load is coming. We have to get ready for it.

Bob, I certainly appreciate the insight that you had here this morning and I thank you for a very good presentation. (Applause)

Mr. Cantrell: At this time I would like to turn it over to Don Steele.

Mr. Steele: Good morning, gentlemen. Our next presenter is Don Ladner, engineer of design for the Wisconsin Central since 1988. Don graduated from the University of Illinois at Chicago in 1973 with a degree in structural engineering and materials. He joined the Chicago and North Western as a management trainee in September, 1973, and held various positions including bridge engineer, assistant bridge engineer inspector, and bridge and building supervisor while there. Don is a member and past director of the American Railway Bridge and Building Association, a member of AREA and he serves on Committee 8.

Last year, this presentation was held as a backup and we promised Don that he could give it this year. Please welcome Don Ladner. (Applause)

WCL BRIDGE REPLACEMENT AT SAULT STE. MARIE

Don Ladner

**Engineer of Design
Wisconsin Central Ltd.**

Wisconsin Central began operations on October 11, 1987, and is currently the largest regional railroad of the United States with 2,137 route miles. We operate in Illinois, Wisconsin, Minnesota, the upper peninsula of Michigan, and in the province of Ontario. We primarily serve the paper, forest products, steel, and intermodal industries.

Since its beginning, the Wisconsin Central has earned a reputation as a leader in quality and customer satisfaction. We are the first railroad in the United States to ever win Distribution Magazine's Quality Carrier Award five years in a row. There are other awards of which we are equally proud.

What is Wisconsin Central? The Wisconsin Central Transportation Company is more than just WCL. It is comprised of the Limited, Wisconsin Railroad Cars, the Sault Ste. Marie Bridge Company, the newly formed Fox Valley and Western, which we have recently closed on, that has added 466 rail miles to the total, and Wisconsin Central International, which is a new subsidiary that has been added to the company to acquire the assets of New Zealand Rail.

This shows WCL on the Fox Valley and Western. There is our new system map. (Laughter) I have been told that our market development people intend to contact NASA and go along on the first Mars shot to see if there may be some intermodal potential. (Laughter)

The 1.2 mile long Sault Ste. Marie Bridge Company was originally constructed in 1887 and it replaced the car ferry operation that connected the United States and Canada. Included in this is a vertical lift bridge that replaced the original swing span over the American locks. They were replaced to accommodate vessels up to 1,000 feet. There was a double-leaf truss bascule built in 1913 when an additional lock was added, and a swing span over the Canadian locks which are currently closed. However, they are going to be remodeled and reopened for pleasure boat traffic.

There are also nine thru-truss spans through the St. Mary's River that connects Lake Superior and Lake Huron and the bridge over the Canadian Power Canal serving Great Lakes

Power Limited, which is the subject of this report.

In addition to the connections with CP and Algoma Central Rail, Wisconsin Central provides rail service to St. Mary's Paper, which is a large employer in Sault Ste. Marie, Ontario, and Algoma Steel Corporation, which is the largest steel producer in Canada.

Prior to start up by the Wisconsin Central, the Sault Ste. Marie Bridge Company was jointly owned by CP Rail and the Soo line, but operated by CP. They were nice enough to give us their half of the bridge company for a dollar at closing.

The Canadian Power Canal bridge consisted of 204 foot pony truss spans constructed in 1887 and five deck girder spans constructed in 1917 when the canal was enlarged. The CP had placed a restriction on the bridge requiring empty or idle cars to be placed between loaded cars up to 241,000 pounds gross weight. This restricted loads going in and out of Canada to 89 tons over the bridge making it difficult to provide rail service to customers.

Some loads had to be partially transferred to go across the bridge. Others were forced to take alternate routes between the United States and Canada. It was a common sight to see several empty tank cars in the yard at Sault Ste. Marie, Michigan, for use as transloading of products such as clay which is a product used in the paper making industry by St. Mary's.

Following start up, Alfred Benesch Engineers of Chicago was retained by Wisconsin Central to analyze the bridges within Sault Ste. Marie. This analysis indicated that cars could be loaded up to 241,000 pounds without the idler cars but the pony truss spans prevented operation of fully loaded 100-ton cars to 263,000 pounds. The report indicated that the replacement of those two pony truss spans would be a cost-effective way to increase the capacity of the bridge. But like so many worthwhile projects, this one was forced to wait until capital budget money could be allocated.

Approval was finally received to proceed with the replacement of the spans in the summer of 1991. For two years before that, I had reminded our management that winter comes early up in Sault Ste. Marie and if we were to get started, I wanted to be done by September. We didn't quite make that, but everything worked out well anyway.

Having never worked in Canada before, we were somewhat unprepared for the red tape involved. This was nothing like working in Michigan which was only half a mile to the south. The engineering firm of Rosewell and Associates of Sault Ste. Marie, Ontario, and Alfred Benesch teamed up to try and design project management services.

While all of our Canadian engineers that bid the job solely had considerable highway bridge experience, none had done a railroad bridge before. We were pleased to see a local engineer team up with someone with reputation for quality railroad services.

One of the other things that was different about working in Canada was all the acronyms are different. There is no DNR; it's the Ministry of Environment. The FRA is the Ministry of Transport, and OSHA becomes the Ministry of Labor.

The first major hurdle that we had in this project was getting a power canal to be declared non-navigable. Prior to that, it had been, but I don't know why. Plans were prepared and contracts were awarded with Wisconsin Central acting as agent for the bridge company and general contractor of the project.

Anybody who has ever been his own general contractor knows why you pay somebody else to do it. However, by doing so we saved about \$150,000 on this project over the turnkey price quoted by the low bidder.

Prior to modification of the abutments, there was considerable reinforcement required because the new deck girders would fit inside the pony trusses. We drilled into the stone and placed Dywidag anchors routed in and then basically post tension in the stone masonry. The abutments and center pier required modifications to accommodate the deck girders. This work was done by LA Construction of Sault Ste. Marie, Ontario. Nearly all of our contractors were local which was very good because they were there all the time and we were very pleased to get the good service that we did out of them.

You can see the concrete paving at the bottom. About ten years ago, Great Lakes Power shut down the power canal and built the dam on the upstream end and basically paved the whole thing in concrete which is great for getting water through the power company, but it made the water go quite a bit faster.

The new spans would require the removal of nearly five feet of stone in the bridge seat areas. You can see the anchor bolt coming up out of the masonry where we post tensioned in the stones adjacent.

Nets had to be deployed. The steel contractor refused to work over moving water without a net and we agreed with his choice. All fall protection measures were consistent with the then current Wisconsin Central requirements and Canadian regulations. The power canal under the bridge flowed at about eight knots requiring the deployment of lifelines downstream and maintaining a boat on-site. A contingency plan included Great Lakes Power being prepared to shut down their plant within minutes in case anyone was in the water.

It was necessary to secure work permits from Immigration Canada for the WCL people working on the project. Most of the work was done by local contractors except for certain track work and the application of bridge ties, which was done in Michigan. We did have to get green cards, except in Canada, green cards aren't green; they are actually brown and look more like a hunting license.

In an area still recovering from a recession, this project was the largest construction job within 100 miles so it received quite a bit of attention from the news media and local safety inspectors.

The center pier was drilled to accept a cutting wire saw that cut through the masonry bridge seat. You can see there was a fine line that is actually a vertical cut in the stone. It is about five feet deep. The saw worked really well. As a matter of fact, it almost worked too well. While they were making the cut, they started cutting the lateral plate in the picture there.

While the pier work was progressing, girder planks manufactured by Algoma Steel were shipped to Kena Steel Limited of Sault Ste. Marie, Ontario, for fabrication.

These planks are made up of an 84 inch by 9/16 web plate and 220 inch by 2 1/2 inch thick flanges that were machine welded into a beam nearly 90 inches deep. This is actually a big welded live flange. The flange plates are fabricated. To fabricate the wide flange beam, the web plates and flange plates are arranged in a girder bed that travels under stationary welding heads. After a pass through on one side, the girder is turned over and the other side is welded. This process is capable of welding wide flange beams up to 92 inches in depth.

The crane to turn over the beam is really all that governs that process. It is limited to individual pieces up to 17 tons or 100 feet in length. These particular girders were fabricated in about a 50-foot center section and then we had to weld splices at about the quarter points. In fact, this process worked so well for Algoma Steel that they don't produce any of their structural shapes larger than 24 inches by rolling; they weld them all.

The welded splices were x-rayed to ensure the strength of the connections. All of the flange to web plate welds were ultrasonically tested. The steel used in the three plate girders was Canadian Steel Association Standard GA40.2150AT or 50AT for short. This material is similar to ASTM 588 atmospheric weathering steel with 50 KSI yield point. It has likely better mechanical properties than 588. The 588 material was used for all secondary members. My engineer asked what color we wanted the spans painted, but we indicated none on the plans. The steel was atmospheric weathering and we intended to let it weather. The primary reason for that is that anybody who has had to do painting over water understands the environmental nightmare involved in retrieving all of the paint and we figured the easiest way to avoid repainting the bridge was never to paint it in the first place.

Bid documents called for current AREA specifications. However, considerable effort went into converting them into something a Canadian contractor could understand. Canadian

Welding Bureau specifications were called for on the drawings along with the AWS counterparts. Wherever one was superior to the other, it prevailed.

Pier work was completed by the beginning of November, 1991. No job would be complete without a historical record. They were maintained by Wisconsin Central personnel and our consulting engineers. The first span weighing 75 tons was assembled on three flat cars for shipments to Sault Ste. Marie, Michigan, for installation of the bridge ties.

It was necessary to clear U.S. and Canadian customs for this move. A document fee was due for bringing the spans into the country temporarily and duty was paid to Canadian customs for importing the bridge ties and the rail.

Steel erection frames were assembled in preparation for the first span changeout. There were several construction methods that were considered at the beginning and the erection frame was chosen for a variety of reasons. The use of two cranes which is customary for a span changeout was ruled out because the existing bridge was deficient in weight-carrying capacity and would not support a heavy lift by cranes.

Two other alternatives included shutting down the power canal so that we would have non-moving water and do it all by vessel. The power company kind of put an end to that. They weren't interested in going out of business. The other idea that was suggested by one of the contractors was a barge installation tied off to the piers and we thought that that was probably not a good idea.

On Monday, November 11, 1991, span one was brought over from Michigan and it was time to find out if the plan that we had worked on for so long would work. Dominion Bridge, who had installed the original pony truss spans 104 years earlier, was the steel contractor on the job. They jacked the new span up off the deck of the flat cars and suspended the girders from the erection frame by way of the threaded Dywidag bars allowing the flat cars to be returned to Michigan along with the switch engine.

Most of the work was done at night. You can see all the little Christmas tree lights along the side. We looked like a Christmas tree sale lot, but it was better than having just a couple of big spotlights because this way we had uniform lighting. The floor system of the bridge was cut out in sections and hauled out by using change hoists attached to a trolley that ran along the bottom flange of the new span. That was designed by our Canadian engineer. The original plan called for numbering all the pieces, dropping them in the water, and retrieving them, but the power company and the Ministry of Environment had problems with that.

Removal of the floor system was completed by the following morning and the jacking process began to lower the new span. It was basically a succession of threading and screwing the span down tight by setting up the jacks, lowering them, screwing them down. It moved at about a foot and hour.

This was completed by Tuesday night but very cold temperatures slowed the curing process of the grout placed under the bearings. A 45-minute curing time turned into 14 hours. The entire procedure was repeated the following week for span two. The second span went faster than the first one. Dominion Bridge was convinced that if there would have been five or six of these to replace, they probably could have had the span changed out in about eight hours. As it was, the first one took about 30 and the second one about 24.

On Wednesday, November 20, the first train crossed the bridge without the weight restriction. This would allow fully-loaded cars to operate between the U.S. and Canada. The old trusses were removed using WCL's locomotive crane and a crane rented from the Algoma Central.

The new girder spans are shown here following the removal of the old trusses that have been donated to a business group that hopes to use them as part of a lake-front recreational development in Sault Ste. Marie, Ontario. The new bridge was dedicated on December 10, 1991, with a ribbon-cutting ceremony that officially opened the gateway to 100-ton rail traffic. As noted earlier, Dominion Bridge had installed the original span some 104 years

before so it seemed appropriate to inquire about an extended warranty on the new spans. (Laughter) They stand behind their work. I was told that if I wanted to, to give them a call in another 104 years and they would do it again.

The new bridge complete with walk and handrail was constructed at an approximate cost of \$1 million U.S. The highway bridge shown to the east of the railroad bridge should benefit from the span replacement since fewer trucks may use the bridge in the years ahead as logs and other raw materials going into Canada, and steel, paper, and lumber and other finished products coming into the U.S. find a more economical route to cross the border by rail.

In our first full year of operation after the elimination of the weight restriction, car loadings across the bridge nearly doubled.

I would like to take this opportunity to give special thanks to the Wisconsin Central people, our consulting engineers, Canadian Customs and Immigration, and a great team of contractors who helped make this project a great success. Thank you for your attention. (Applause)

Mr. Cantrell: Thank you, Don. It's too bad we had to wait so long to watch that presentation. It was very interesting. I would like to remind everybody that we appreciate your coming, but I would like for you to be sure to pick up a conference survey. Be sure and get those filled out. We want to have quality presentations and that is one way we can continue doing that. We, as roadmasters, and I know the B&B Association also wants very much to give programs that pertain to us.

At this time, we have with us Warren Peterson of FAST. Warren comes to FAST from a varied background with the Soo Line. He graduated and got his degree from Michigan Tech in 1953. He held various positions on the Soo Line and 1986 he became vice-president of operations for them. Then in 1990 he became a consultant for the Soo Line. In 1991, he assumed the present position that he now has at FAST at the test center.

In addition to Warren's work experience, he served as reserve consultant to the University of New York at Buffalo and is past president of the AREA. Warren.

VEHICLE AND TRACK TESTING

Warren Peterson

Association of American Railroads

Thank you, Darrell. I very much appreciate the opportunity to participate in this 1993 annual conference of the Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association.

I know from a lot of years in railroad engineering that the kinds of things that your organizations do in terms of benefiting the industry from a track and structure standpoint have been extremely beneficial over a lot of years and a lot of hard work by you and your committees.

When I was more directly involved in AREA, I always strived to form a closer relationship in those activities with respect to the AREA committees and your committees. I think that is starting to accelerate some now which will benefit all three organizations.

To Ken and Paul who have steered this conference and have put this together, from all the comments I have heard including what the REMSA folks have to say, this is probably one of the most successful combined Roadmasters, B&B, and REMSA meetings that has ever

occurred. I know from the suppliers' point of view in talking to some of those folks that they are extremely pleased with what has transpired over these two and a half to three days. So to Ken and Paul and to all of you, my congratulations.

The presentation this morning is with respect to the Transportation Test Center. I'm going to break it into three parts if you will.

First of all, I would like to give you a brief introduction in terms of the background of the Transportation Test Center and what our goals and objectives are. I am sure that a number of you folks are quite familiar with the center and probably have been there, but I think a number are not so I will give you that kind of a background as an introductory presentation.

Following that, earlier this year we just completed a video that certainly will give you a feel for the types of things that are going on far better than I could do in terms of standing up here and talking about it. Then more specific to your interests with regards to track component, track performance, the third part of the program will be given by Rich Reiff, our manager of civil engineering. He will give an update on what is happening with the heavy axle load project and more specifically, how track components are performing when they are subjected to a 125-ton loading environment. Those are the three segments and I will get right on with the introductory remarks.

The Transportation Test Center located near Pueblo, Colorado, is a world class, inter-modal research and test center offering a wide range of capabilities for research, development, and evaluation testing of ground transportation systems.

This federally owned, 52-square mile facility is operated and maintained by the Association of America Railroads Research and Test Department specifically under a long-term care, custody, and control agreement with the Federal Railroad Administration.

I might add that in just the last quarter of last year we successfully negotiated a new ten-year contract with the FRA for continued operation of the Test Center. The Test Center is self supporting with revenues from a wide range of customers including government, freight and passenger railroads, transit and commuter agencies, car and locomotive builders, track and structure material suppliers, and hazardous material training students.

The Transportation Test Center is an excellent example of a successful privatization of a federally-owned facility. As a result, the long-term viability of an essential transportation research and testing resource to meet both government and private sectors is ensured.

The Transportation Test Center is operated as a private business without any benefit of subsidies or grants from the government. We are a business and I might add that since we are run by the AAR and with the AAR being a trade association, our business plan is non-profit; that is revenue is equal to expenses.

The site includes 48 miles of railroad track devoted to testing all types of rolling stock, track components, signal and safety devices. Included among test tracks are the high tonnage loop which is involved in the performance of the heavy axle load program which you will be hearing about from Rich Reiff.

There is the railroad test track and transit test track for high speed vehicle testing and the precision test track for vehicle testing on track and the wheel rail mechanism loop for steady state and dynamic curving tests. These and other specialized tracks are used daily to evaluate stability, safety, life cycle reliability and ride comfort. Past tests have included vehicles as varied as light rail transit cars, an eight-axle nuclear waste car, and a high speed passenger locomotive.

Utilizing the Transportation Test Center test tracks eliminates the interference, delays and safety problems accompanying testing on an operating railroad or commuter or transit system allowing the efficient, economical and safe completion of testing procedures under totally controlled conditions. I would like to add, too, that in addition to the tracks that we now have, that being some 48 miles worth of test tracks, there are an additional six miles or

so of auxiliary tracks.

We now have initiated a study jointly with FRA to determine what is needed to take our railroad test track, which is a very flat 14.7 mile oval, maximum 50 minute curves, to bring that track up from its current testing range of 100 to 125 miles an hour up to 150 miles an hour. That is an assessment we are currently performing to determine obviously what the cost will be and create a cost benefit study. But that ties in with what you all, I'm sure, have been reading about with respect to the HSGGT program or High Speed Guided Ground Transport Systems. We are looking to actively participate in that program and obviously we need the high speed facilities and high speed tracks to do that.

In addition, we are working with a consultant to determine the cost and design of what would amount to, or what is being called, an ultra-speed oval which will be a track that will essentially go around the perimeter of the 52 square mile site to allow 200 mile an hour testing. This, again, ties in with where this nation is hopefully headed in development of high speed guided ground transportation systems. In this regard, I believe that the Test Center will play a very active and beneficial role.

What are our goals and objectives? Well, since the Test Center is literally owned by the federal government, they have goals and objectives for the place. Since we operate it and maintain it in the interest of AAR, we do also. In the FRA's case, it is to establish that Transportation Test Center as a world class intermodal test center, "for the conduct of comprehensive testing, evaluation, training, and associated development of ground transportation systems and their components by the Department of Transportation organizations."

This was a result of the new contract we just negotiated by Department of Transportation organizations, going beyond what has, in the past, been quite focussed and limited to FRA participation to allow other DOT agencies the benefit of that kind of resource; for example, the Federal Transit Agency and the Federal Highway Association.

The government has officially allowed the center to be utilized by the Department of Transportation. We feel that is an extremely important fact as far as our future is concerned.

With respect to the AAR research and test department, our goals and objectives facilitate beneficial technological change for railroads by conducting research for AAR and FRA, conducting certification tests in support of railroad interchange standards, supplying test skills and facilities for railroads and supply companies to carry out proprietary tests and product development. Also, very importantly, to attract other business, particularly transportation related, to allow cost-effective use of the Test Center facilities by the railroad industry, by commuter and transit agencies, and by the government.

So those are the goals and objectives. It is a very broad scope, but they are very well targeted to the purpose of the continued viability of the Center.

With respect to the future, I mentioned that we are looking to play an extremely active role in the development of high speed guided ground transportation systems. I don't know, and I don't think anybody in this room does frankly, where the funding is going to wind up at this point in time and that's obviously the big question. But certainly I do believe everyone in Washington is in agreement that this country needs to move in this area and participate in this program and, secondly, to significantly expand our participation in the international market.

We do quite a bit of work internationally but we see as we extend our marketing efforts to the international market, immense opportunities for the kinds of testing and research services that we have to provide.

As I indicated, this is a world class facility and, very honestly, there is no other facility in the world that has the capabilities that the Transportation Test Center currently has. We have a lot of international visitors. Without exception when they leave the place they are literally amazed at having made the realization and understanding and tour of the place and now understanding what we can do for them.

We have done extensive work in India for the Indian Railroads. We have done a lot of

work in Brazil. Some of this will be mentioned in the video. We just recently did some work for London Underground in London. We are looking for some work in other countries throughout the world as well. But there is competition out there as there is in any business. We are hoping to get a piece of the action.

So without further comment, I would like to show you the video and then we will get into the heavy axle load project. Mike, if you would start the video.

(Where upon there was a video presentation)

Mr. Peterson: I think it is interesting to note with respect as to how we sometimes go in huge circles. When the Test Center was first constructed in the early 1970s, its intent, and it was 100 per cent federally funded, was to provide a facility for prototype high speed ground vehicles. The most successful endeavor amongst five or six attempts of different types was a linear induction motor vehicle called a LIM vehicle that ran steel wheel on steel rail on conventional track construction, but to very high standards propelled by motion system and was a linear induction motor with a large aluminum reaction rail down the center of the track.

That was 20 plus years ago. That vehicle hit speeds of about 255 miles an hour and set a high speed ground transportation speed record that was held for a long time until it was broken by either the Japanese or Germans fairly recently.

Ten years of that kind of work led to the AAR's assumption of the responsibility of the place in 1982. But here we are 20 years later very seriously involved in, again, the development of high speed ground transportation system in this country. So maybe we have lost some ground over those years with respect to allowing for the technological advancement within our country, but it is still not too late for us to move ahead.

For the third segment of this presentation, I would like to introduce to you Mr. Richard Reiff, one of our managers at the Test Center for civil engineering projects. He is site manager specifically for the FAST heavy axle load program. He also has the responsibility for AAR's lubrication research, which is becoming increasingly important, as you heard during the double-stack derailment presentation earlier this morning.

Mr. Reiff's background includes being track supervisor with the Rio Grande as well as holding railroad engineering and research positions at the Transportation Test Center, with the Federal Railroad Administration, and with the Northeast Corridor Railroad Improvement Project. Rich holds a civil engineering degree from the University of Illinois.

May I present Rich Reiff.

Mr. Reiff: Thank you, Warren. We are running a little late so I'm going to give a fast presentation on the FAST program. This will give a preview for those of you who are coming down for tomorrow's tour. We will open up the track and you will have a chance to kick the ties and look at the switches and some of the track components that we will be talking about.

Very briefly, the FAST heavy axle load program is designed to determine what the effect of increased axle loads is on conventional track materials and track maintenance methods. For a very brief background, you have heard Warren talk about the Test Center. Here is our 50-square mile area. The FAST track is just one of many loops that are shown here.

Specifically here is the Loop or what we call the high tonnage loop. It is a 2.7-mile loop. We do lubricate the outside rail only for rail fatigue tests to reduce wear. The inside rail is kept primarily dry so we can get our rail wear test conducted at the same time on the one Section Seven reverse curve. Those are five and six degree curves.

Regarding the very brief operations, the 2.7 mile loop, we run the train at 40 miles an hour. We change directions daily or every other day. On approximately one million gross tons, we alternate directions of the train. Then we turn the trains occasionally so we even out all the wheel wear.

It is fully lubricated most of the time except for approximately every three million gross tons when we dry down the track for our ultrasonic inspection. That is typically when we are running a full train of 75 to 80 cars, a couple of 100-ton cars in there for control purposes,

five locomotives, about 13,000 tons per train.

Here is a typical FAST train and a typical green summer out at the Test Center with the blue skies.

What do we mean by heavy axle load car? Very briefly, a 125-ton car is often called that because it holds approximately 125 tons of lading as opposed to a 100-ton car. Everything is about the same as a 100 tonner except for the wheel size. It has 38-inch wheels instead of 36-inch wheels. Of course the weight on rail is about 39,000 pounds per wheel. Here is a typical 125-ton heavy axle load car at FAST and as we'll mention at the end here, this is conventional equipment. These are conventional three-piece trucks. To compare with our old data base, all we did was increase the train weight, keeping the train suspension about the same. In other words, scaling up the load.

These are our major tests areas. Again, we won't have time today to review all of these, but rail, ties, fasteners, ballast, turnouts, track maintenance or track degradation, and a little bit of wheel performance. We do have major tests in every one of these areas.

What did we find? Well, no surprise after our first 160 MGT. Yes, when you increase the weight on the rail, you do get increased degradation. Where does it occur? It gets more severe but this is it using conventional track materials and maintenance methods.

So our current phase is what can we do about this? We have installed a number of premium components, improved components, turnouts, better rail, and we are currently involved in evaluating those products to see what can be done with existing types of equipment.

For a crossing frog evaluation, the main purpose of this test was to evaluate the standard design crossing frog for metal flow, wear, maintenance, and strains and get some idea of what the bending stresses were in the casting. Here is what it looked like when we put it in track. Obviously we don't have a big enough loop to run both directions so all the data was taken in one direction.

This is what it looked like after 1.9 million gross tons of traffic or approximately 150 train passes. We had about one-eighth inch of batter. Obviously not suitable. This was a non-hardened frog, which is standard rail components. This has become our baseline. What happens when you put a non-premium component in the track and run heavy axle loads? It doesn't last.

There is some data showing a cross section before and after the flangeway. Not only did we get excessive batter vertically, but the flangeway actually started to collapse inwards, reducing the flange clearance. This is after, again, 12.9 million gross tons.

This is an example of the strain environment. Ideally what would happen is with every wheel pass, you would get a blip and it would come back up to its previous point. Those major steps that you see as the data working its way down is permanent strain of the castings. So that's one train pass and you are getting deformation during each train pass and within each train pass of this crossing frog.

Here is the next victim. This is a three-rail crossing. It had some premium rail in it. After one MGT, we had to build up the ends. This is what it looked like after four MGT operations. I think 4.2 is when we pulled it out. Again, it was taken out due to major deformation of the components. We are in the process of rebuilding this crossing with super premium rail of 370 hardness micro alloy head hardened rail. You will see that tomorrow as well.

Another major test is the below track modulus experiment. Basically you are conducting this program because initial results of the FAST heavy axle load test indicated very little impact of track maintenance on cyclic out-of-face ballast surfacing and lining operations.

Where we had the biggest problems is with joints, but overall it showed very little effect on the out-of-face maintenance requirements. A lot of the railroad engineering community felt that wasn't correct so to address the effect of track maintenance in less than ideal conditions, we simulated a soft subgrade by building what we call our bathtub. In effect, we removed some of the native soil to a depth of about 5 feet, 12 feet wide, built a trough, and

backfilled it with an engineered clay, a very carefully prepared buckshot clay, and created what we felt was a soft condition. It turned out to be pretty close to the target of modulus of around 2,000 compared with the standard FAST modulus of around 4,000 to 5,000 pounds per inch. The subgrade was compacted and moisture content checked and then a conventional track structure was built on top of this soft bed where we could operate the train and compare degradation and maintenance on a marginal subgrade with that of a very good subgrade.

There were no surprises. Yes, things started to go bad relatively rapidly. The red line is the track geometry of the soft section as constructed, this being the profile. The yellow represents the same section after 13 million gross tons of traffic. So we had some major settlement and major deviations in the profile.

In this case, if we compare profile degradation between the standard track and the soft track, the yellow represents profile degradation standard deviation of our stiff section or our normal fast subgrade. As you can see, we had some initial degradation in the first three to four million gross tons and then it settled out and it is holding pretty good.

The soft subgrade section has required numerous maintenance cycles. It degraded up to a standard deviation of about .3 and then we had to, due to cross level problems, maintain it and bring it back down as best we could and then it degraded again. Again, no real surprise, but we have now what we call a calibrated track that is soft and calibrated track that is stiff. We will be using these in the future to show the effects of the next phase of FAST which will be improved track suspension.

Here is some more data that shows on the horizontal scale. The horizontal scale is the standard deviation of the track profile and vertically is the standard deviation of the wheel load. So what this gives us is the relationship with our conventional trucks. These are the standard trucks that are just overloaded and shows that as the track get rougher, of course the load goes up. You get a higher pitch and bounce. You get more load into the track which causes more degradation.

The next phase of FAST and we will touch on this at the end, is we intend to replace all of the trucks in that train with a premium suspension design. The design is intended to reduce the vertical loads into the track and reduce the dynamic loads into the track, so we should see a reduced rate of degradation. In other words, there should be longer times between maintenance cycles and when the track degrades to a certain roughness, we should see a lower load input into that track because the suspension will be taking up some of that track. That is how we will be evaluating the economics of these new trucks.

I will briefly touch on the rail seat abrasion test zone. Again, we are looking at the effects of different techniques for repairing or preventing concrete tie rail seat abrasion. That is what the rail seat abrasion looks like when the rail has been removed. It is effectively a form or type of tie plate cutting but in this case, it is the tie pad working its way into the concrete.

Here are some very initial results showing the amount of abrasion with different types of tie pads. What we see here is the rubber pad shows a lot lower abrasion than the much harder EVA pads. So one might think the first answer is put in rubber pads. Unfortunately, on a five-degree curve, a rubber pad's life is very short. So we are working on some different combinations of dual durometer pads and dual rate pads where you are combining a soft and hard pad to reduce that rail seat abrasion.

Finally, we'll talk very briefly about the future of FAST. On the left, you will see our comparison blocks where we determine what the effect was of increasing axle load. We took data from the last phase of the 100-ton car operation and compared it to the 125-ton car operation and that's the data we just talked about.

We use the final phase of the extended operations of that car to get our true effects of the heavy axle load.

The next phase which will start the actual operation in early 1995 will be to repeat many of these tests, but with a train of advanced suspension vehicles. What we have conducted is a series of computer simulations to select these trucks. We have put these in what we call a mini test frame where we shortened the FAST train temporarily, running anywhere from a 25 to 15-car train made up primarily of prototype examples of these advanced suspension trucks to determine which ones will last and which ones will give us the best reduction in load into the track.

Here are three examples. This is a shear plate type truck. What it looks like might be a good ballast regulator as well. There is a plate that runs from one spring nest to the other to help stiffen this truck and help it steer through some of the curves thus reducing lateral loads. There are some additional suspension modes in this truck to reduce the vertical loads. It doesn't look much different other than that plate underneath there.

Here is another truck design which has some improved wedges again to help stiffen the truck and make it steer better as it goes around the curves and some pads as you can see above the bearing adaptor to help reduce the vertical load.

Finally, this is a radial truck. All the linkages are very difficult to see. They are inside from one side to the other. It looks very typical. As you can see, we are not talking some real exotic looking type trucks, but ones that will cost more.

The purpose of the next phase again will be to determine if these advanced suspension trucks reduce track damage to the point where heavier axle loads have become economical and the increased price of the truck and its maintenance is reflected in reduced maintenance of the track. That will be our primary objective of FAST, to study the effects of the improved suspension.

We will be continuing other tests like rail grinding, and turnout testing. As manufacturers and suppliers provide improved components, we will be putting those in the track as well to determine what is really the best in each area. As other heavy axle load areas present themselves, we will attempt to put those into the FAST track and study those effects.

I want to emphasize that FAST is a joint effort with the supply industry, the railroad industry, and the FRA all contributing either money or equipment. It has been a very successful program going on over 20 years. These are the areas we will be stressing in the next phase of FAST. These are areas especially sensitive to changes in the truck design, load path, various forces in the subgrade, wood ties and fasteners, concrete ties, rail wear, turnout components, especially the frog area, track geometry and maintenance requirements primarily in the low track modulus zone, thermite weld performance and some mechanical joint batter.

I apologize for rushing this. We did start a little late. I don't think we have time for questions, but I will be available for the rest of today and FAST engineering staff will be available tomorrow out on the track to answer your questions in detail. Thank you. (Applause)

Mr. Steele: Thank you, gentlemen. We gained a lot of knowledge and expertise from your research facility and this helps us provide a better service for our customers.

Our next feature is the SEPTA Bridge Program. Here with us today is Dan Lynch and Chris Rood. Mr. Lynch holds a position of senior program engineer in the engineering and construction division of the Southeastern Pennsylvania Transportation Authority, better known as SEPTA, in Philadelphia, Pennsylvania.

SEPTA is the fourth largest public transportation operation in the United States. As senior program manager, Mr. Lynch has overall responsibility for all aspects of SEPTA's \$290 million rail works capital improvement program. Mr. Lynch will present the project background, planning, and operational aspects of the project.

Mr. Chris Rood, also with SEPTA as senior project manager, will discuss the details of the construction phase.

Prior to his 13 years employment with SEPTA, Mr. Lynch spent ten years with Conrail

in various engineering capacities. He received his undergraduate and graduate degrees in civil engineering from Drexel University in Philadelphia, Pennsylvania. He is a member of the American Society of Civil Engineers, a former member of the AREA, and holds a professional engineer's license in the Commonwealth of Pennsylvania.

Mr. Rood has been with SEPTA for six years. Prior to working at SEPTA, Mr. Rood worked ten years at Amtrak in their structures' department in both Washington, DC, and Philadelphia. Mr. Rood received his undergraduate degree in civil engineering from Penn State University and a graduate degree in civil engineering from Drexel University in Philadelphia. He is a member of the Bridge and Building Association, American Society of Civil Engineers, AREA, and holds a professional engineer's license in the Commonwealth of Pennsylvania.

Please welcome Dan and Chris.

SEPTA BRIDGE PROGRAM

Dan Lynch

Senior Program Manager

Chris Rood

Senior Project Manager

South Eastern Pennsylvania Transportation Authority

Mr. Lynch: Thank you, Don. Let me also thank the Bridge and Building Association for expressing interest in the SEPTA rail works project and inviting Chris and me here to talk with you today.

Our purpose this morning is to cover some of the planning, operational, and construction aspects for one of SEPTA's largest capital improvement programs called rail works which was subsequently completed earlier this month.

The main element of this \$290 million project was the replacement and rehabilitation of 25 bridges on a four-mile section of SEPTA's regional rail division. The regional rail division provides heavy rail passenger service for 90,000 daily riders in and around the City of Philadelphia.

As noted in the introduction, SEPTA is one of the largest public transportation agencies in the nation having a combined annual operating and capital budget in excess of \$875 million. SEPTA's operations include a fleet of 1,400 buses operating 110 routes through Philadelphia and its suburban counties. We also operate 164 track miles of elevated subway and surface light rail transit. There are 485 track miles of heavy rail passenger service on which we operate passenger service to more than 160 station.

The heavy rail passenger service, or the regional rail division as we call it, is made up of 13 branch lines of mixed single and double track territory which feed into an eight-mile, four-track central trunk line. The main trunk line runs underground through Philadelphia's central

business district. At either end of the Center City tunnel, trains operate above grade on a series of bridges and retained earth viaducts to Wayne Junction in North Philadelphia and to Amtrak's 30th Street Station in West Philadelphia.

Except for the Center City tunnel section and the lines to the Philadelphia airport, both completed in the 1980s, most of our regional rail division operates over bridges and fixed plant originally built around the turn of the century by the Pennsylvania and Reading Railroads.

Starting in the 1980s after taking over ownership and direct operating responsibility for the passenger rail network, SEPTA began to make large capital investments in upgrading and modernizing the physical plant using federal funds made available by the Surface Transportation Assistance Acts of the 1980s and currently by ISTAEA, the Intermodal Surface Transportation Assistance and Efficiency Act.

Major improvements and upgrades have been and continue to be made in all areas including track signals, electrification, structures, and new equipment. Since 1984, the capital bridge program, for example, has replaced or rehabilitated more than 20 per cent of the 257 bridges on the regional rail system.

Here are a few examples. This is new multi-span deck girder structure built a few years back to replace an approximately 100-year-old high steel, open deck trestle. Here is one of our shorter spans where we installed new precast, prestressed concrete boxes. This replacement was performed on weekends and nights. Here you can see a new thru-girder bridge being readied for a weekend whirlwind during a weekend service outage.

We have also done a number of heavy rehabilitations. Here you can see a new floor beam and stringer going in. We have salvaged the girders on this bridge. We have a number of concrete arches on our system.

Let me move now to the main topic of our presentation. The scope of physical plant improvements which we completed under our rail works project was quite extensive. It included bridge replacement, catenary renewal, and everything in between. The construction corridor is located on the north end, shown here in yellow, of our central trunk line which I discussed a little earlier. Construction work started just north of the new Center City tunnel and continued four miles to Wayne Junction to where this main trunk line converges into a two-track operation.

Because of the way our northern and southern branch lines are paired together through our Center City tunnel operation, all 400 of our daily regional rail trains operate over this central section of our system. Early in the start-up phase of our capital bridge program, the majority of the 25 bridges along this four-mile section were identified for replacement due to their state of deterioration and key location within our central trunk line.

Deciding how to replace these 25 bridges quickly and at a cost we could afford while operating rail passenger service on a reliable schedule was a subject of considerable study and analysis during preliminary engineering. We looked at all the usual scenarios including very limited night and weekend outages or attempting to do the work on single or double tracks at a time.

Performing the bridge replacements and other civil and electrical work, which we recently added to the project, under service would have exposed our service to daily system-wide delays because of the pairing operation through the tunnel and would have lasted over five years. Construction costs would have easily doubled or possibly even tripled.

What we ultimately decided to do was to suspend service over this four-mile section of our system and package all the construction work into two consecutive construction windows of only six and four-month durations each. We made this decision chiefly because we were able to come up with a reliable alternate service plan.

The operating plan consisted of splitting the service into two halves, south and north of the construction zone, and running two stub end terminal operations south of the project

using two existing Center City stations. On the north end of the project, located at this white oval, we constructed a new interchange facility so that our riders coming in on our northern routes could transfer to a new interchange station between the regional rail division and our Broad Street subway line, which is the vertical orange line running here, to continue the trip to downtown Philadelphia.

This new interchange station was just one of several support projects which we constructed prior to suspending services in order to improve the service on the Broad Street subway line to provide efficient alternate service.

Before turning things over to Chris, I'm just going to cover some of the construction details for you. I want to mention a little about teamwork on this project. Completing a project of this size and complexity in the extremely tight timeframes of two construction windows only totaling ten months required, as I'm sure you can imagine, a tremendous amount of planning and engineering. It also required exceptional teamwork. To borrow a phrase from our construction management consultant, we created a recipe for disaster. One of the principle things that he was referring to was a large number of organizations involved with carrying the project out. There were actually eight prime contractors on the project with a total of 74 subcontractors. Some of the subcontractors were actually larger than some of the prime contractors on the project.

We had a joint venture design team that also had numerous consultants who had to provide us close construction support during construction for shop review, overseeing conditions, and responding to inquiries from the contractor. We had a construction management consultant with seven subconsultants. We had consultants working the area of community relations, public relations, and also affirmative action.

Then there was SEPTA with multiple departments consisting of engineering, construction, operations, and contract management. Also adding to the drama was a three to four month change-over cycle for dealing with unforeseen field conditions during construction and liquidated damages of over \$70,000 a day for failure of the contractors to return our operation at the end of the construction window.

To help us establish the teamwork needed to be successful on this project, we headed a two-day partnering workshop shortly after we awarded all the construction contracts. More than 100 people from every organization involved in the project got together in a two-day, off-site seminars. This gave us all an opportunity to express our concerns, talk about our goals, learn a little bit about each other, and begin to build the atmosphere of trust and cooperation needed to carry out this project.

We also followed up this initial two-day partnering session with several smaller one-day workshops with smaller groups to cover specific problem areas.

The end result was that our partnering experiment worked. The time we spent on building teamwork through this process paid off in a big way. We finished on time, within budget, and without a single major delay, claim, or unresolved construction issue.

At this point, I would like to ask Chris to come up and take us through some of the construction details.

Mr. Rood: The four-mile section which rail works encompasses runs through a section of North Philadelphia in an area which is mainly dense residential and light commercial beginning at Center City and traversing across the street grid heading northward out of the city.

The bridges in this area had all been built between 1906 and 1911 as part of a grade separation project ongoing at that time by the City of Philadelphia. They had seen virtually none, if any, real maintenance in the last 40 years. Their waterproofing and drainage systems had failed causing deterioration even to the patch plates.

Most had nonfunctional bearings and many had extensive deterioration of their steel bridge members. For the most part, the bridges were three-span riveted steel construction,

with the main span over the street and the adjacent approach spans over the adjacent sidewalks with the bridge columns on the curb line. There was also a two-span open deck bridge with a span over a Conrail freight line.

Of the three-span bridges, some were thru-girders with built-up floor systems and some were of deck girder design. There were also concrete arches which early in the design were slated to be rehabilitated, but the results of a preliminary concrete investigation indicated that the arches had reactive concrete. Therefore the arches were slated for replacement.

The bridges weren't the only bad portion of the fixed plant in this section. The overhead catenary system was also in need of replacement, virtually having had little maintenance since its original installation in 1935. Portions of the track structure including two major interlockings were also in need of extensive work.

Combining these needs with the bridges and other needs within this corridor, the project evolved into a system infrastructure improvement project.

The major work elements included replacement of 21 bridges and the repair of another four, replacement of eight miles of track, renewal of 16 miles of overhead catenary, replacement of two major interlockings, installation of new single and power control cables, construction of a new Temple Station and new right-of-way fencing, retaining wall work, catenary structure rehabilitation, duct bank installation, and the rebuilding of an existing station at North Broad.

The work was broken up into manageable pieces in the specific construction contracts with construction to be phased over the two periods that Dan mentioned earlier. There were actually six general construction contracts, two electrical contracts, and one small mechanical contract with his main focus associated with the new Temple Station.

Phasing and packaging was basically dictated by street detouring capability attempting to minimize impact on the neighboring community and access and staging requirements necessary by each of the contractors. We had three of the nine total contractors working over both construction periods, with the other six working either the first or the second construction period.

During the first phase, we had two electrical, one mechanical, and four general contractors. In the second phase, we had one electrical, one mechanical, and three general contractors.

As stated earlier, the majority of the work was to occur over two construction periods, one of six months duration and one of four months duration, whereby train service was suspended. However, the contractors really didn't have that amount of time.

Major milestones established in each contract dictated several key coordination areas. For example, the general contractors were not able to begin until five days after the beginning of each construction window. Those five days were needed by the electrical contractors to remove the signal, power, and catenary systems in the areas of the general contractors' activities. At the end of each window, the general contractors lost between 30 and 35 days since they had to have all their track work completed. This obviously meant that the bridges all had to be complete, to allow time for the electrical contractors to complete installation of new signals, new power, and new catenary systems in those areas. These work elements needed to be completed in time to allow SEPTA force account ten days to do the extensive testing of the new signal and power systems required prior to the resumption of revenue service.

So the actual construction period for the general contractors was actually between four and five months in lieu of six in the first window, and a little less than three months instead of four in the second window. With that limited amount of time and the amount of work that had to be done, much of the work had to be done around the clock, six to seven days per week. It was indeed a tight schedule.

The new bridges, with the exception of the two concrete arches, were basically updated versions of the original bridges, but in a modern design. That is a thru-girder or deck girder design with new deck floor systems of either steel plated deck or concrete encased floor

beams and stringers. Wherever possible, we attempted to eliminate curb line columns, but were successful in doing so at only three locations. We had an envelope of space to fit the bridges. We had to maintain or improve the underbridge roadway clearances, and we were restricted with the overhead catenary height and/or track line and grade. The abutments were all reused although with some reactive concrete problems existed. However, they are massive gravity abutments and therefore highly stable.

The replacement of the bridge seats and the back walls, however, was done at most of the bridge locations. The typical scenario for the steel bridge requirements was that after the power systems were removed, the track system, including the waterproofing system, was remanufactured. The bridges were either torched, cut out, or torn out. Once the steel was removed, the old back walls and bridge seats were removed, and then the new construction began. New back walls and bridge seats were installed, then the new steel was erected.

The majority of the new bridges were erected in place. However, two were done as roll-ins. This was primarily the contractor's decision since he felt he didn't have sufficient time in the construction window to complete all of his bridges unless he proceeded with other alternatives, other than cutting them out and lifting them back in place.

Once the steel was in place, the decks were placed. After the deck installation, a membrane waterproofing system combined with two layers of protection board was installed in addition to a drainage system. Then the track system was installed consisting of new ballast, new wood ties, and new 132 CWR.

The replacement of the concrete arches was a little unique since incorporated into their replacement were the entrances into a new station. Once the power systems and track systems were remanufactured, demolition on the arch began. The arch, along with its north abutment, was removed and excavation for the new north abutment began. We dug a big hole and then we started to fill it in first with lean concrete which was resting on rock and then the rest of the abutment.

After the abutments and piers were completed, the steel was erected. The deck girders were also completed and you can note the construction of the high level platforms. That occurred in the first window in this scenario. After the concrete deck, waterproofing and drainage systems were installed and the track system was renewed.

The Temple Station was completed in the latest window. As it stands today, we have the two concrete arches, one that serves as the main entrance into the new station, and the other arch which serves as a second entrance into the station.

The four bridges that were rehabilitated were basically all done in a similar manner. Our largest rehab was a separate general construction contract in itself. The rehab that I'm going to show was of a 3,400 foot long steel viaduct approximately 60 feet wide. The deck was stripped of the track structure and the existing waterproofing system. Existing concrete deck overlay was removed and replaced with a fiberized concrete overlay.

Because of access difficulty, the contractor did the actual deck overlay removal and the new deck overlay installation by cutting the bridge in half because he only had one access at the south end of this elevated viaduct and one access at the north end.

After the deck and the new parapets were installed, the waterproofing, drainage systems and the track systems were installed. The underside of the structure and the work that this encompassed included rivet replacement, a deteriorated structural members replacement, bearing replacement, and cleaning and painting of the entire structure. Other work in the project included interlockings. At this interlocking situated in a cut section, everything was completely gutted. We then installed the new drainage system, a new subbase or new subgrade, new ballast, new rail, new ties, new special track work, new signal and power cables, and new air-operated switching machines.

At this interlocking we replaced all the special track work and the electric switch machinery. This interlocking was done without a complete shutdown since we had to maintain access

into both ends of this car shop. We had to always keep at least one track open through the work site to allow cars to enter into the maintenance shop. Therefore, the work had to be done under service with scheduled shutdowns within the actual construction window.

Also done with the bridges and the track work was the replacement of approximately 16 miles of overhead catenary. The catenary system basically consists of a three-wire incline system. Also the catenary structure was not renewed, but the station alignments were rehabilitated, steel repairs made, cleaned and painted, a new string of cables run, wall work, right-of-way fencing done and a new underground duct bank system to house the new power, signal, and communication cables was installed.

The total cost for the third party construction contracts was approximately \$140 million, a number substantially under the budget mainly due to the economic conditions and competitive market at the time of bidding. We basically started bidding these contracts all the way back in 1991.

The time taken in preconstruction planning for this job was enormous with over four years of planning and design for actually ten months of construction. The construction contracts were bid and subsequently awarded up to two years prior to construction. This was mainly done to allow the contractors themselves sufficient time to plan their respective work and to also procure the materials especially since much of the material required a long lead time.

To stress the importance of this project to the contractors, many contractual additives were placed in the contracts. In addition to major milestone dates and liquidated damages and to ensure material deliveries, a requirement that was in all the construction contracts was that all the major materials had to be on-site and inspected at least 70 days prior to their respective window with the bridges required to be shop fit and inspected prior to shipment. Also the special track work was required to be shop fit and inspected prior to shipment.

We have accomplished our objective. We completed this project with the highest degree of quality, on time, and under budget. It was an entire team effort. Cooperation, communication, and coordination of all the parties involved were the keys to this project's success. We built new connections, not only in terms of new bridges and new stations and other infrastructure repairs, but in lasting relationships with the contractors, the consultants, the neighborhood, our riders and within SEPTA itself. Thank you. (Applause)

President Welch: Thank you, gentlemen. Those of you that are departing, be sure and fill out your conference surveys if you will please and give it to anyone wearing a white director's ribbon.

At this time I would like to call on Reuven Shiloh for the report of the resolutions committee. Reuven.

REPORT OF THE RESOLUTION COMMITTEE

Having reached the closing of the annual joint conference of Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association, and being deeply indebted to all those members and friends who have contributed their time and effort to make our conference a success, it is right that we should acknowledge this indebtedness and it should be entered into the minutes of this meeting.

Be it forever resolved that our deep appreciation be extended to those who have honored our Association by their presence and by their informative addresses. Stan McLaughlin, vice-president engineering, Union Pacific Railroad; Dennis E. Waller, vice-president engineering and materials, Chicago and North Western Transportation Company; Charles Burroughs, president of the American Railway Engineering Association; Jerome D. Hines, president of

Railway Engineering Maintenance Suppliers Association; Bill Stokely, Florida East Railway; David K. Franz, Kansas City Southern Railway; Stephen J. Hill, Canadian Pacific Rail System; Michael Ongerth, Southern Pacific Transportation Company; Tom Reilly, M.F. Bank Restoration Company; Vincent Terrill, Terrill Track Consultants; Roger Cross, CSX Transportation; John Blanchfield, Norfolk Southern Corporation; Bob Scanlon, Southern Pacific Transportation Company; Bruce Bradshaw, Pandrol Jackson; Del O'Neal, Southern Pacific Transportation Company; John Samuels, Conrail; Bob Cartwright, Union Pacific Railroad; Don Ladner, Wisconsin Central; Warren Peterson and Rich Reiff, Association of American Railroads; Dan Lynch and Chris Rood, SEPTA; and to all the committee chairmen and sponsors with the loyal cooperation of the committee members who prepared the interesting and instructive reports that have been presented.

Be it forever resolved that a very special thank you is expressed to Jerome D. Hines, president of REMSA, and to all members of the Railway Engineering Maintenance Suppliers Association for the fine reception and hospitality that we enjoyed during our conference.

A thank you is also expressed to Mrs. D'Anne Welch and Mrs. Barbara Saletnik and their committee members for their efforts in arranging registration and entertainment for our wives.

A special thank you goes to Pat Weissmann and Barbara Marlow. Without their unselfish assistance, these two Associations would have great difficulty functioning.

Be it finally resolved that both Associations express their heartfelt thanks to our retiring presidents, Ken Welch and Paul Saletnik, who have spent so much time and effort in guiding the activities of our Association with great efficiency and dedication over the past year.

I move these resolution to be adopted.

Respectfully submitted,

Reuven Shiloh

Resolutions Committee

President Welch: At this time, I would like to add my personal thanks to everyone whose name Reuven read. I think our presenters have been absolutely excellent. Thanks certainly go to Jerry Hines and Judi Meyerhoeffer with REMSA, and to everybody who has been involved. This has been a truly outstanding success from our perspective and hopefully from yours.

President Welch: At this time, I would like to call some of our outgoing directors for whom this is their last term and make a little presentation to them.

Herb Clark, who is not here right now.

Jim Young. Jim, it has been a great pleasure working with you. I wish we could keep all of you guys for another four years, but nevertheless, we really appreciate it.

Mr. Young: Thank you. (Applause)

President Welch: Ron Poulsen, you are not really going away and I'm not sure everybody understands that, but we appreciate your time as a director. Ron will be treasurer next year. I appreciate it very much.

Mr. Poulsen: Thank you. (Applause)

President Welch: Ken Koff. Ken, we appreciate your efforts this past year. Ken will also be with us on the executive board.

Mr. Koff: Thank you. (Applause)

President Saletnik: We have three outgoing directors, two of whom couldn't be with us right now. John Creighton, B&B master, CP Rail; and Johnny Bradley, assistant division engineer from Norfolk Southern. However, the gentleman who is with us is Mr. Don McCammon. I would like to give him an extra special round of applause because he helped put the ladies' activities together and the ladies had a great time. (Applause)

Thank you for the outstanding service. We appreciate it.

Mr. McCammon: I would also like to reiterate thanks to everyone involved and a

special thanks to Don Steele for his support and coordination on behalf of the B&B. A special thank you to Darrell Cantrell as well. Those two guys really put together a good program. A special thanks to REMSA, especially Jerry Hines and Judi Meyerhoeffer. Thank you very much. (Applause)

JOINT INSTALLATION OF OFFICERS

President Welch: At this time I would like to call on Steve Hill and Mark Walbrun.

Mr. Hill: It is now our duty to announce the new directors of each of our organizations. This is a list of the officers elected to the Roadmasters and Maintenance of Way Association of America for the administrative year 1993-1994. Will the officers so named please come forward as we call your names.

For president, Gene Schubel, assistant manager engineering, Burlington Northern, Springfield, Missouri; for first vice-president, Keith Nordlund, project manager, CN Railway, Toronto, Ontario; for second vice-president, Ken Koff, railway construction maintenance engineer, Frederic R. Harris, Los Angeles, California; for treasurer, Ron Poulsen, director of construction, Union Pacific Railroad, Omaha, Nebraska.

For Directors with terms ending in 1994: Wayne Russell, general director of roadway maintenance and planning, Santa Fe Railway, Kansas City, Kansas; Ray Brosseau, assistant supervisor program maintenance, CP Rail, Toronto, Ontario; Dave Smoot, executive vice-president, Indiana Hi-Rail, Evansville, Indiana.

For Directors with terms expiring in 1995: Darrell Cantrell, who has really been doing an excellent job at this conference. He is manager of service agreements, Burlington Northern, Fort Worth, Texas; Ken Johnson, who had to leave, assistant division engineer, CSXT, Mobile, Alabama; Dave Kelly, vice-president and chief engineer, Illinois Central, Chicago, Illinois.

For Directors with terms expiring in 1996: Al Cloutier, assistant division engineer, Amtrak, Riverdale, California; Reuven Shiloh, director of engineering planning and support, Conrail, Philadelphia, Pennsylvania; and Pete Murgas, engineer procedures and administration, Norfolk Southern, Atlanta, Georgia.

And our new Directors for terms expiring in 1997: Tom Roy, manager of maintenance operations, C&NW, St. Paul, Minnesota. Unfortunately, Tom could not be here with us. Dwight Clark, manager special projects engineer, Union Pacific, Omaha, Nebraska; and Bob Davis, manager tie gangs, Southern Pacific, Redlands, California. Mark.

Mr. Walbrun: The following is a list of the officers elected to the American Railway Bridge and Building Association for the administrative year 1993-1994.

Would the officers so named please step forward and take a position in front of the podium.

For president, Don Steele, manager bridge construction, Union Pacific Railroad, Omaha, Nebraska; for senior vice-president, John Van Huis, chief engineer structures and production, Wisconsin Central Limited, Fond du Lac, Wisconsin; for junior vice-president, Mike Bradley, project engineer, Conrail, Columbus, Ohio; and Joe Lilikis, manager of bridge maintenance, Union Pacific Railroad, Salt Lake City, Utah. For treasurer, Don Lewis, bridge construction engineer, Illinois Central, Chicago, Illinois.

Our Directors with terms expiring in 1994: Bob Carter, general B&B supervisor, Springfield, Missouri; Carl Young, project engineer, Conrail, Carleton, Michigan; and Dave Franz, bridge engineer, Kansas City Southern, Kansas City, Missouri.

For Directors with terms expiring in 1995: Lee Hostler, structural engineer, AT&SF, Albuquerque, New Mexico; Jimmy Neece, B&B supervisor, CSX, Mobile, Alabama. Jimmy

is not here with us today. Ron Kaye, Joliet, Illinois.

For Directors with terms expiring in 1996: Mark Johnson, director of bridge engineering, Burlington Northern, Overland Park, Kansas; Tim Rich, engineer B&B, Conrail, Etters, Pennsylvania; and Dale Bartholomew, senior project manager railroad facilities, Sverdrup Corporation, Kirkland, Washington.

Elected to a position of leadership in any organization is a distinctive honor that entails a great deal of responsibility. Your fellow members, in electing each of you to your respective office, have expressed confidence in you. First, that you will discharge your several duties with distinction; and second, that you are willing to do so.

Mr. Hill: As the officers of our Association, you will represent to the citizens of this country the true meaning of railway bridge and building and railway maintenance and construction. You will be our collective voice in the industry. Thus, you will be our common bond with railway personnel throughout the United States and the world.

Mr. Walbrun: As the officers of our Association, you will represent our best interest in any of your activities or projects. Always remind yourself that your attitude must be a part of any undertaking sanctioned by your respective organization. In this, you will be adhering strictly to the constitution and the bylaws of our Associations.

As a representative of the American Railway Bridge and Building Association, I install each of you into the office to which you were elected in your Association.

Mr. Hill: As a representative of the Roadmasters and Maintenance of Way Association of America, I install each of you to the office into which you were elected in your Association.

Please remain standing so Mark and I can come down and congratulate each of you. Can we have a round of applause for these gentlemen. (Applause)

President Welch: At this time, I would like to call on Jerry Hines with REMSA.

Mr. Hines: Thank you, Ken. On behalf of REMSA, I congratulate the Roadmasters on their election of Gene Schubel as president, and the B&B on their election of Don Steele as president.

To help these two gentlemen conduct the business of their respective Associations, REMSA has engraved gavels for each new president and I would like to ask Gene and Don to come forward. Good luck and thank you for your help. (Applause)

I would now like to ask Ken Welch and Paul Saletnik to come forward.

The Roadmasters and Bridge and Building associations have been fortunate this year with good leadership in the persons of Ken Welch and Paul Saletnik. I have the privilege of presenting each of them with a plaque which captures REMSA's expression of thanks for the superb cooperation in which they have conducted the affairs of their respective organizations and in working with other industry associations to make the railway supply and railroad industries truly great.

Thank you, Ken and Paul.

Ken, thank you for all your help. It has been great. Paul, thank you. Enjoy it and good luck. (Applause)

President Welch: A year ago when I accepted this position, I was stunned quite frankly and really honored, but I have to tell you it has been a long tough year. I have really been honored to do this and I have been honored to work with your directors.

Gene, we wish you all the best luck and I wish you well and I'm sorry for you at the same time because your work is cut out for you. (Laughter)

Mr. Schubel: Ken, thank you.

At this time I would like to present a plaque to you, Ken. Ken has really done a great job. He started a lot of initiatives on this board that got us heading in a really positive direction. If you were not aware of it, he just really pushed this organization in the right direction. He is really to be commended and thanked. (Applause)

President Welch: I owe you something, too. Here is your new president's pin. Wear it wisely and keep pushing. Thank you. (Applause)

President Schubel: I would like to make a few comments, but I will keep this brief. I woke up this morning with a fear of speaking in front of a large group of people in a large room. Well, it looks like I was half right. It is a large room. (Laughter). Recently I read some tips on giving a good speech. It said that first of all, you need a good beginning. Secondly, you need a good end. The third thing you need is to make those two things come very close together. So that's what I'm going to do here. (Laughter)

I am both proud and honored to be chosen as president of this 110-year-old organization. I promise along with the Board to try and continue the efforts to improve the organization and make it more responsive to the railroad industry's needs. I don't know what you think, but this has been a great conference and it is really going to be hard to top. Railroaders love seeing equipment and seeing how it works.

Technology is very important. We have gotten great productivity gains from that, but there remains just one vast untapped resource and that's people. With a dedicated and trusting workforce, great things can be accomplished. If you have ever been on a team, a sports team or a work team, and gotten the job done, you know it is amazing what you can do when you are all pulling in the same direction.

Railroads do have a long way to go to get that type of work force. The one key way to get there is through training.

The theme of next year's conference is training for the 1990s. The groundwork of that conference actually began back in Chicago in 1992 when some of you suggested topics for this conference. I hope to have the kind of program that you want and that is a hands-on, professional conference that roadmasters and other maintenance-of-way professionals needs. If we aren't doing that, let us know. You can write me, you can call me, you can call the Board's office, and you can call any other director and let them know how we can serve you better.

If you haven't participated in a presentation, why not try it. It can be very educational and rewarding. If you are chosen to be the chairman, we even give you your own personal speech coach to help you give the best talk you can.

Now for that quick ending. Next year is "Training for the 1990s," in 1994, Chicago. See you then. (Applause)

President Steele: Thank you, Gene. Paul, would you come up please. Paul, your board of directors and myself wish to thank you for leadership over this past year. You, along with Ken Welch, have assisted in pulling off the largest and most attended conference to this date.

From all the comments I have received from the attendees, this was the greatest. So, Paul, for all your support and service, we want to present you with this plaque and we thank you very much.

Mr. Saletnik: I truly consider it a real privilege to serve as president of the B&B Association and would like to reiterate that all of the work would not have taken place if it was not for the teamwork involved or the people on the board.

I would like to especially thank Don and let you know that he is going to be one of the best presidents we ever had because of his close attention to detail. I know he will be an excellent president. Good luck. (Applause)

President Steele: Thank you. I want to thank you, ladies and gentlemen, and especially the members of this Association, for giving me the privilege to serve as your president in the ensuing year. It has been an honor just to belong to this select group of well-versed and talented people who strive to keep railroads operating at top speeds and at the lowest possible cost.

But it is much larger honor to be selected to lead this elite group for this year. I, with your hard work and assistance, will help keep us on the course of continued improvement.

In our constitution, we, as an Association, established to uphold the advancement of

knowledge pertaining to the design, construction, and maintenance of railway structures and fixed facilities by investigation, reports, and discussions.

We can educate and inform the railway industry in how to do our work safely, more efficiently, and more economically with improved quality. This can only continue with the work and participation by you, the members of this Association.

Our Association has been challenged by the stockholders and upper management of our various companies. They question the old ways of how we do our work and we must establish new ways and better methods to do this work.

The B&B Association was established in 1891 to accomplish this task. Over the past few years to continue our efforts, we have been holding educational seminars, providing thought-provoking presentations by our members at these conference, and inviting special speakers from the many firms involved in the railroad and construction maintenance areas. We have also been making changes in our constitution to meet today's constantly changing environment.

In order to protect our well being as well as our fellow workers in the railway industry itself, we must meet this challenge and prevail.

This Association as well as other associations in our industry must not only stay involved within our own areas of expertise, but must join together for the betterment of the industry and the associations. The demands today require us to be knowledgeable in all aspects of maintenance-of-way work. We must work closely with AREA whose expertise is in the technical side of the railroad construction and maintenance. Any of you who belong to this organization as well as the Roadmasters, I applaud you for your thorough involvement and unselfish efforts in helping the railroad industry succeed. It is the close cooperation of the Roadmasters Association and ourselves that will benefit both groups in making each of us more responsive to the demands of our memberships and the industry itself.

We also need to continue to work with the members of REMSA who support this Association and our industry. It is from this group of people that we get better equipment, products, and processes to do our work meeting our goals and improving safety, quality, and productivity. REMSA does rely on us for new ideas concerning the methods, equipment changes, and improvement in this existing technology.

Our railroads' upper management has given us this challenge and must also continue to support us in our quest to keep the railway industry viable and on track. This support has to come in the form of promoting their employees' involvement with our Associations. Without this support, we stand a good chance of dwindling and the loss of the organization itself and I don't feel the industry can afford this loss.

As I stated before, we must work together as members of our Associations and other associations to create a synergy to accomplish a fruitful path into the future. Get involved in your Associations and participate on the committee reports or chair one yourself next year and stress the importance of the Association to your fellow workers and management.

Thank you and may your families have a bountiful and safe year.

Is there anything else anyone would like to bring before this conference? If not, the Roadmasters and the B&B want to thank REMSA for such an outstanding equipment show. We all learned a great deal from the experience of seeing this equipment and talking to your representatives. I also want to thank all of the presenters and attendees for making this conference a success.

I trust everyone will have a safe journey home and I hope to see you in Chicago next year.

I declare the 1993 Annual Concurrent Conference for the Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association closed. (Applause)

Adjourned.

Past Officers

	1891-1892	1892-1893	1893-1894	1894-1895
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews
1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
3rd V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard
4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stannard
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin
	C. W. McGehee	Q. McNab	James Stannard	R. M. Peck
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane
	1895-1896	1896-1897	1897-1898	1898-1899
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	L. J. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman
	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. G. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley
	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	W. O. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt
	1907-1908	1908-1909	1909-1910	1910-1911
President	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O. Eggleston	A. E. Killam	J. N. Penwell	I. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912	1912-1913	1913-1914	1914-1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullem	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923	
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway	
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood	
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson	
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright	
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson	
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty	
Asst. Sec.			F. E. Weise	F. E. Weise	
Directors	{	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
		A. B. McVay	A. B. McVay	J. H. Johnson	Maro Johnson
		J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
		E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
		C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
		G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres.	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	H. B. Batey	H. B. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
Directors	W. A. Batcy	R. P. Luck	T. P. Soule	G. S. Crites
	C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCloy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941	1941-1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary			F. O. Whiteman	A. G. Shaver
Treasurer			F. E. Weise	F. E. Weise
	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
Directors	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefling	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefling	K. L. Miner	W. A. Sweet	Martin Meyer

	1942-1943	1943-1944	1944-1945	1945-1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

† To November 1, 1942 ‡ To February 1, 1943

	1946-1947	1947-1948	1948-1949	1949-1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
Directors	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950-1951	1951-1952	1952-1953	1953-1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
Directors	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

	1954-1955	1955-1956	1956-1957	1957-1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
Directors	{ E. R. Schlaf	J. M. Lowry	G. W. Benson	H. H. Matthews
	J. F. Warrenfells	W. H. Bunge	J. M. Lowry	T. M. VonSprecken
	H. D. Curie	E. R. Schlaf	T. M. VonSprecken	W. H. Bunge
	J. M. Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958-1959	1959-1960	1960-1961	1961-1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
Directors	{ E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962-1963	1963-1964	1964-1965	1965-1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	R. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
	Shirley White	R. D. Hellweg	W. F. Armstrong	J. A. Goforth
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	E. R. Simmons
Directors	{ R. D. Hellweg	W. F. Armstrong	J. A. Goforth	N. D. Bryant
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	A. R. Dahlberg
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	J. S. Ellis
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	T. L. Fuller

	1966-1967	1967-1968	1968-1969	1969-1970
President	R. D. Hellweg	J. W. DeValle	W. F. Armstrong	J. A. Goforth
1st V.-Pres.	J. W. DeValle	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg
2nd V.-Pres.	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg	T. L. Fuller
3rd V.-Pres.	J. A. Goforth	A. R. Dahlberg	T. L. Fuller	N. D. Bryant
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
	N. D. Bryant	J. S. Ellis	N. F. Lucas	W. H. Rankin
	A. R. Dahlberg	T. L. Fuller	W. L. Short	E. E. Runde
	H. F. Lucas	R. A. Youngblood	C. E. Wachter	T. A. Reynolds
Directors	{ J. S. Ellis	H. F. Lucas	A. C. Jones	J. J. Ridgeway
	T. L. Fuller	W. L. Short	W. H. Rankin	J. R. Williams
	R. A. Youngblood	C. E. Wachter	E. E. Runde	J. W. Chambers
	V. D. Raessler	A. C. Jones	T. A. Reynolds	R. E. Frame
	W. L. Short	W. H. Rankin	J. J. Ridgeway	J. C. Hobbs
	C. E. Wachter	E. E. Runde	J. R. Williams	

	1970-1971	1971-1972	1972-1973	1973-1974
President	A. R. Dahlberg	T. L. Fuller	N. D. Bryant	E. E. Runde
1st V.-Pres.	T. L. Fuller	N. D. Bryant	E. E. Runde	J. J. Ridgeway
2nd V.-Pres.	N. D. Bryant	E. E. Runde	J. J. Ridgeway	J. R. Williams
3rd V.-Pres.	E. E. Runde	J. J. Ridgeway	J. R. Williams	W. R. Rankin
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
	T. A. Reynolds	J. W. Chambers	R. K. Corbett	D. C. Gould
	J. J. Ridgeway	R. E. Frame	J. R. Iwinski	W. S. Stokely
	J. R. Williams	J. C. Hobbs	J. S. Pritchett	W. C. Sturm
Directors	{ J. W. Chambers	R. K. Corbett	D. C. Gould	J. W. Davidson
	R. E. Frame	J. R. Iwinski	W. S. Stokely	C. A. Hughes
	J. C. Hobbs	J. S. Pritchett	W. C. Sturm	W. R. Hyma
	R. K. Corbett	D. C. Gould	J. W. Davidson	O. C. Denz
	J. R. Iwinski	W. S. Stokely	C. A. Hughes	R. C. McMaster
	J. S. Pritchett	W. C. Sturm	W. R. Hyma	W. E. Brakensiek

PAST OFFICERS

	1974-1975	1975-1976	1976-1977	1977-1978
President	J. J. Ridgeway	J. R. Williams	W. H. Rankin	J. R. Iwinski
1st V.-Pres.	J. R. Williams	W. H. Rankin	J. R. Iwinski	W. C. Sturm
2nd V.-Pres.	W. H. Rankin	J. C. Hobbs	W. C. Sturm	D. C. Gould
3rd V.-Pres.	J. C. Hobbs	J. R. Iwinski	D. C. Gould	J. W. Chambers
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
	J. W. Davidson	W. E. Brakensiek	J. W. Chambers	W. J. Gunkle
	C. A. Hughes	O. C. Denz	M. Noyszewski	W. E. Halley
	W. R. Hyma	R. C. McMaster	W. J. Gunkle	K. L. Wammell
Directors	W. E. Brakensiek	F. R. Lindsay	W. E. Halley	J. Budzileni
	O. C. Denz	M. Noyszewski	K. L. Wammell	B. J. King
	R. C. McMaster	W. C. Sturm	J. Budzileni	J. G. Robertson
	F. B. Lindsay, Jr.	W. J. Gunkle	B. J. King	O. C. Denz
	M. Noyszewski	W. E. Halley	J. G. Robertson	E. C. Patterson
	Jim Payne	K. L. Wammell		W. S. Stokely
	1978-1979	1979-1980	1980-1981	1981-1982
President	W. C. Sturm	D. C. Gould	J. W. Chambers	W. R. Hyma
Sr. V.-Pres.	D. C. Gould	J. W. Chambers	R. C. McMaster	O. C. Denz
Jr. V.-Pres.	J. W. Chambers	R. C. McMaster	W. R. Hyma	J. Budzileni
Jr. V.-Pres.	R. C. McMaster	W. R. Hyma	O. C. Denz	J. M. Williams
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Pat Weissmann
Treasurer	W. F. Armstrong	W. F. Armstrong	W. F. Armstrong	W. C. Sturm
	J. Budzileni	O. C. Denz	J. W. Davidson	D. A. Bessey
	B. J. King	W. J. Gunkle	C. M. Russell	J. N. Michel
	J. G. Robertson	W. S. Stokely	J. M. Williams	P. H. Saletnik
Directors	O. C. Denz	L. D. Green	D. A. Bessey	O. D. Anthony
	E. C. Patterson	C. M. Russell	J. N. Michel	J. T. Kapp
	W. S. Stokely	J. M. Williams	P. H. Saletnik	D. J. Lewis
	L. D. Green	D. A. Bessey	O. D. Anthony	J. W. Davidson
	C. M. Russell	J. N. Michel	J. T. Kapp	H. J. Laga
	J. M. Williams	P. H. Saletnik	D. J. Lewis	A. S. Uppal
	1982-1983	1983-1984	1984-1985	1985-1986
President	O. C. Denz	J. Budzileni	J. M. Williams	D. A. Bessey
Sr. Vice President	J. Budzileni	J. M. Williams	D. A. Bessey	J. T. Kapp
Jr. Vice President	J. M. Williams	D. A. Bessey	J. T. Kapp	D. J. Lewis
Jr. Vice President	D. A. Bessey	J. T. Kapp	D. J. Lewis	R. A. Tallent
Secretary	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann
Treasurer	P. H. Saletnik	P. H. Saletnik	P. H. Saletnik	J. M. Williams
	O. D. Anthony	J. W. Davidson	T. E. Kuhn	B. T. Burns
	J. T. Kapp	D. J. Lewis	D. R. Ladner	J. J. Horney
	D. J. Lewis	T. E. Kuhn	R. A. Tallent	W. J. Semoli
Directors	J. W. Davidson	D. R. Ladner	B. T. Burns	R. E. Fronczak
	H. J. Laga	R. A. Tallent	J. J. Horney	W. P. Cunningham
	A. S. Uppal	B. T. Burns	W. J. Semoli	J. H. Smith
	T. E. Kuhn	J. J. Horney	D. W. Brookings	E. Bond
	D. R. Ladner	W. J. Semoli	W. P. Cunningham	D. L. Steele
	R. A. Tallent		J. H. Smith	M. C. Walbrun
	1986-1987	1987-1988	1988-1989	1989-1990
President	J. T. Kapp	D. J. Lewis	R. A. Tallent	B. T. Burns
Sr. Vice President	D. J. Lewis	R. A. Tallent	B. T. Burns	J. J. Horney
Jr. Vice President	R. A. Tallent	B. T. Burns	J. J. Horney	M. C. Walbrun
Jr. Vice President	B. T. Burns	J. J. Horney	M. C. Walbrun	P. H. Saletnik
Secretary	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann
Treasurer	J. M. Williams	J. M. Williams	J. M. Williams	J. M. Williams
	W. H. Nelson	M. C. Walbrun	C. E. Thompson	W. H. Nelson
	J. H. Smith	S. Lipkus	H. L. Davidson	T. J. Parker
Directors	J. J. Horney	D. L. Steele	J. A. VanHuis	R. C. Karsten
	M. C. Walbrun	C. E. Thompson	W. H. Nelson	R. C. Carter
	E. Bond	H. L. Davidson	T. J. Parker	T. V. Dunn
	D. L. Steele	J. A. VanHuis	R. C. Karsten	M. L. Bradley
	C. E. Thompson	W. H. Nelson	S. Lipkus	D. G. DeBerg
	H. L. Davidson	T. J. Parker	T. V. Dunn	D. F. Sorgenfrei
	J. A. VanHuis	R. C. Karsten	M. L. Bradley	J. A. Lileikis
	1990-1991	1991-1992	1992-1993	1993-1994
President	J. J. Horney	M. C. Walbrun	P. H. Saletnik	D. L. Steele
Sr. Vice President	M. C. Walbrun	P. H. Saletnik	D. L. Steele	J. A. Van Huis
Jr. Vice President	P. H. Saletnik	D. L. Steele	J. A. Van Huis	M. L. Bradley
Jr. Vice President	W. H. Nelson	J. A. Van Huis	M. L. Bradley	J. A. Lileikis
Secretary	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann
Treasurer	J. M. Williams	D. J. Lewis	D. J. Lewis	D. J. Lewis
	R. C. Carter	D. G. DeBerg	D. L. McCammon	R. W. Carter
	T. V. Dunn	D. F. Sorgenfrei	J. T. Creighton	C. W. Young
Directors	M. L. Bradley	J. A. Lileikis	J. G. Bradley	D. K. Franz
	D. G. DeBerg	D. L. McCammon	R. W. Carter	J. L. Hostler
	D. F. Sorgenfrei	J. T. Creighton	C. W. Young	J. L. Neece
	J. A. Lileikis	J. G. Bradley	D. K. Franz	R. W. Kaye
	D. L. McCammon	R. W. Carter	J. L. Hostler	M. L. Johnson
	J. T. Creighton	C. W. Young	J. L. Neece	T. Rich
	J. G. Bradley	D. K. Franz	R. W. Kaye	D. E. Bartholomew

CONSTITUTION

(Revised September 18, 1990)

ARTICLE I

NAME

Section 1. This Association shall be known as the American Railway Bridge and Building Association.

ARTICLE II

OBJECT

Section 1. The object of this Association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway structures and fixed facilities by investigation, reports and discussions.

Section 2. The Association shall neither endorse nor recommend any particular devices, trademarks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the Association in regular session.

ARTICLE III

MEMBERSHIP

Section 1. The membership of this Association shall be divided into five classes: Members, Life members, Associate members, Honorary members and Junior members.

Section 2. A member shall be a person in the railway industry (except representatives of manufacturers and/or suppliers of equipment, material or labor services) engaged in engineering, construction and maintenance of railway structures and fixed facilities; a person in the employ of a public regulatory body; a professor of engineering or architecture; a technical editor; a materials expert; a consulting engineer, or an engineer employed by a consulting engineering firm, engaged in the engineering, construction and maintenance of railway-related facilities; an engineer employed by a technical service or research and development organization; or an officer or engineer of an engineering or scientific society or association whose aims and objectives are compatible with the aims and objectives of this Association. Any person desirous of becoming a member shall make application upon the form prescribed by the Executive Committee, setting forth the applicant's name, address and practical experience. The applicant shall be recommended by at least one member of the Association to whom they are personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the Executive Committee, a majority vote being necessary in either instance.

Section 3. To be eligible for a life membership, an individual must have belonged to the Association for at least 15 years and in general must have retired from active employment due to age or physical disability. A life member shall have all the privileges of previous membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2 of this Article.

Section 4. Associate members shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to cooperate with members in the study and development of improved practices in the construction and maintenance of railway structures and fixed facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article, except that they shall be recommended by either a member or an associate member of the Association to whom they are personally known.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the majority vote of the members present at a regular meeting. They shall have all the rights of members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any person in the Association membership whose conduct in any way diminishes the professionalism or prestige of the Association, or who shall refuse to comply with the rules of this Association, shall forfeit membership in the Association on a two-thirds vote of the Executive Committee.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8. Only members shall hold office in this Association, and only members and qualified life members shall be entitled to vote in the election of officers.

Section 9. Junior members shall be persons engaged in academic study toward a career in those areas described in Section 2 of this Article, but not currently employed in those areas. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members in Section 2 of this Article, except that they need not be recommended by a member of the Association. The term of junior membership shall be limited to five years.

ARTICLE IV

OFFICERS

Section 1. The officers of the Association shall be a president, a senior vice president, two junior vice presidents, a treasurer and nine directors, who, with the most recent past president, shall constitute the Executive Committee.

Section 2. The past presidents of this Association, previous to the most recent past president, who continue to be members shall be privileged to attend all meetings of the Executive Committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the Executive Committee without delay.

ARTICLE V

EXECUTIVE COMMITTEE

Section 1. The Executive Committee shall manage the affairs of the Association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the Association, and make all necessary purchases and contracts required to conduct the general business of the Association, but shall not have the power to render the Association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the Association.

Section 2. Meetings of the Executive Committee may be called by a majority of the members of the committee, providing ten days' notice is given to the executive committee by mail.

Section 3. Five members of the Executive Committee, one of which shall be either the president or a vice president, shall constitute a quorum for the transaction of business.

ARTICLE VI

ELECTION OF OFFICERS AND SECRETARY AND TENURE OF OFFICE

Section 1. Except as otherwise provided, the officers shall be elected at the regular annual meeting of the Association and the election shall not be postponed except by a two-thirds vote of the members present at said annual meeting. The election shall be by vote, a majority of the votes cast being required for election. Any member of the Association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2. The president, two junior vice presidents, and treasurer shall hold office for one year and the directors for three years; three directors being elected each year. The senior vice president shall hold office for one year and ascend to the office of president at the expiration of such service. All officers shall retain their office until their successors are elected and installed. A director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3. The term of office of the treasurer may be terminated at any time by two-thirds vote of Executive Committee. The compensation of the treasurer shall be fixed by a majority vote of the Executive Committee.

Section 4. The secretary shall be appointed by a majority vote of the Executive Committee and the term shall terminate with the appointment of successor. The Executive Committee shall have the power, by two-thirds vote, to remove the secretary and appoint a successor at any time. The salary of the secretary shall be decided by a majority vote of the Executive Committee.

Section 5. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the Executive Committee.

ARTICLE VII

MEMBERSHIP FEE AND DUES

Section 1. Every member, upon joining this Association, shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the Executive Committee.

Section 2. A person stricken from the list of members because of non-payment of dues upon written application may be reinstated as a member in the former class of membership without loss of privileges, either upon payment of all back dues (which must accompany applications) or at the discretion of the Executive Committee voting in the manner prescribed in Section 2 of Article III.

ARTICLE VIII

LOCAL SECTIONS

Section 1. Upon the application of ten or more members of the Association residing in the same geographical district, or having offices therein, the Executive Committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this Association as the section membership may adopt and the Executive Committee approve.

Section 2. The parent Association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

(Revised December 2, 1990)

Time of Meeting

1. The regular meeting of this Association shall convene annually during the month of September, the exact date to be fixed by the Executive Committee.

2. It shall be within the power of the Executive Committee to change the time of the meeting if it becomes apparent that it is for the best interests of the Association.

Place of Meeting

3. The place of holding the annual meeting shall be determined by the Executive Committee not less than twelve months prior to the date of the annual meeting.

Quorum

4. At the regular meeting of the Association, 15 or more members shall constitute a quorum.

Dues

5. The annual dues for the fiscal year ending August 31, and payable in advance, shall be as follows:

Members, \$25.00; Associate Members, \$25.00; Junior Members, \$25.00

Duties of Officers

6. The president shall have general supervision over the affairs of the Association. He shall preside at all meetings of the Association and of the Executive Committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. The president shall render a detailed report at least three times during the year to the members of the Executive Committee, showing the financial condition of the Association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the Association.

7. The vice presidents, in order of seniority, shall preside at meetings in the absence of the president and discharge the duties of the president in case of a vacancy in his office. The senior vice president shall have the senior position of vice presidents.

8. The secretary shall keep a correct record of the proceedings of all meetings of this Association, and of all accounts, between this Association and its members, collect all moneys due the Association, and deposit the same in the name of the Association. The secretary shall pay all bills when properly certified and approved by the president or the treasurer, and make such reports as may be called for by the Executive Committee. The secretary shall sign all contracts or other written obligations of the Association which have been approved by the Executive Committee. The secretary shall also perform such other duties as the Association may require.

9. The treasurer shall have charge of the funds, check all deposits as made by the secretary, and invest all funds not needed for current expenses. The treasurer shall report at each annual meeting on the condition of the finances.

Nominating Committee

10. After each annual meeting the president shall appoint a committee consisting of five members. The most immediate past president shall act as chairperson. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual meeting in accordance with Article VI of the Constitution, said list to be read at the business session of said meeting. Nothing in this section shall be construed to prevent any member making further nominations provided that such nominations are received by the president in writing not less than thirty (30) days in advance of the first day of the annual meeting. Such nominations should be addressed to the president of the Association at its headquarters office.

Auditing Committee

11. Prior to each annual meeting the president shall appoint a committee of three members, not officers of the Association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

Orders of Business

12. Call to order by president.
- Opening prayer or invocation.
- President's address
- Reports of standing committees and presentation of papers
- Election of officers
- Business session
 - Report of secretary
 - Report of treasurer
 - Report of auditing committee
 - Report of necrology committee
 - Unfinished business
 - New business
- Installation of officers
- Adjournment

Decisions

13. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the Association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's Rules of Order.

Amendments

14. The By-Laws can be amended by a two-thirds vote of those present at any regularly called Executive Committee Meeting.



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Anderson T P, Gen Bridge Frmn, C&NW Trans Co, 310 6th Ave N, S St Paul,MN.55075.....	04-06-93
Anthony O D, Chf Engr, B&A RR, North Me Jct Park, RR 2 Box 45, Bangor,ME.04401.....	10-05-71
Applegate D , Mgr Of Bridge Mtee, UP RR, 833 E 8th St, Stockton,CA.95206.....	07-24-91
Bagwell M W, VP/GM, Mississippi Export RR, PO Box 8743, Moss Point,MS.39562-8743.....	03-16-88
Bailey J , Supv B&B Dept, NIRC/METRA, 14736 S Major, Oak Forest,IL.60452.....	08-31-77
Baker R C, Engr Trk & Strs, EJ&E RY, 1141 Maple Rd, Joliet,IL.60432.....	09-14-80
Barrett J E, President, Bowman, Barrett & Assocs, Inc., 233 N Michigan, Chicago,IL.60601.....	12-09-71
Barrett P L, Engr Const & Mtee, AT&SF RY, 4515 Kansas Ave, Kansas City,KS.66106.....	02-17-82
Barron R A, Supv Strs, Conrail, PO Box 234, Sherman Dale,PA.17090.....	04-26-91
Bartholomew D E, Sr Proj Mgr RR Facilities, Sverdrup Corp, PO Box 97062, Kirkland,WA.98083-9762.....	09-15-86
Bateman J D, Mgr Bridge Mtee, UP RR, 8831 Silent Stream, San Antonio,TX.78250.....	12-03-82
Beard E E, B&B Supv, IC RR, RR 1, Box 69B, Sigel,IL.62462.....	07-24-91
Beck C, Supv B&B, NICTD, 601 N Roeske Ave, Michigan City,IN.46360.....	01-06-93
Beebe L C, Mgr Sfty Svcs, UP RR, 1416 Dodge St, Rm 800, Omaha,NE.68179.....	12-04-85
Begg W B, Engr Of Strs, CC&P RR, 1006 E Fourth St, Waterloo,IA.50703.....	10-08-91
Begnaud R A, Engineer II, Amtrak, 2961 Hale St, Philadelphia,PA.19149.....	05-08-84
Beirne M J, Mgr Trk Insp & Dvlpmnt, NS Corp, 110 Franklin Rd SE, Roanoke,VA.24042-0077.....	08-20-76
Beitzel M J, Sr Engr Tech, Modjeski & Masters, 7129 Meadowbrook Dr, Mandeville,LA.70448.....	09-22-91
Belkalouf E , Sr Bridge Engr, Transport Canada, 344 Slater St, Ottawa,ONT,Canada,K1A 0N5.....	09-16-90
Benes R F, Resident Engr, Larsen Engr's, 3955 Yale St, Hamburg,NY.14075.....	04-27-87
Bennett C P, Asst Engr-Grd Sprtn Strs, NS Corp, 99 Spring St SW, Atlanta,GA.30303.....	01-09-90
Bennett D W, Asst B&B Supv, Montana Rail Link, Box 8779-101 Int'L Way, Missoula,MT.59807.....	03-23-92
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Beran J R, Chf Engr, UP RR, 1416 Dodge St Rm 920, Omaha,NE.68179.....	09-07-83
Bessey D A, Asst Chf Engr-Strs (Ret), Milwaukee Road, 4455 Oak View Dr, Sarasota,FL.34232.....	08-31-77
Best R E, Engr, Mgr, Strs., State Rail Authority-New So. Wales, 126 Church St, Parramatta,NSW,Australia.2150.....	09-16-90
Bhalakia M P, Consultant, Engineering Svcs, 8251 E Van Buren Dr SE, Pittsburgh,PA.15237-3732.....	09-16-73
Bibby K C, Mgr Pwr Hse, Amtrak, 210 S Canal St, Chicago,IL.60606.....	10-10-67
Billings J D, B&B Supv, C&NW Trans Co, 375 Beech St, Chadron,NE.69337.....	10-03-74
Billingsley R E, Gen B&B Supv, NS Corp, 8 N Jefferson St, Roanoke,VA.24042-0049.....	12-05-86
Birgenheier J A, Mgr Fab Qlty, BN RR, 9401 Indian Creek Pkwy-14th Fl, Shawnee Mission,KS.66210-2007.....	02-06-89
Bishop G L, Strl Dtlr, NS Corp, 99 Spring St, Atlanta,GA.30303.....	09-20-87
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Boileau R J, Dir Engineering, BN RR, 777 Main St-1900 Cntntl Plaza, Fort Worth,TX.76102.....	03-27-85
Bonas D J, Asst Engr Strs, NS Corp, 99 Spring St SW, Atlanta,GA.30303.....	11-02-83
Bond E , Chf Engr Br & Strs, NS Corp, 99 Spring St SW, Atlanta,GA.30303.....	09-28-66
Boone S H, Asst Chf Engr-Constr., SEPTA, 200 W Wyoming Ave, Philadelphia,PA.19140.....	01-09-90
Boraas R S, Bridge Engr-Dsgn, SP Trans Co, One Market Plaza-Room 1007, San Francisco,CA.94105.....	10-02-86
Borden L V, Associate, Modjeski & Masters, 4909 Louise Dr, Mechanicsburg,PA.17055.....	02-05-91
Borg M T, Gen Supv B&B, BN RR, 20412 Tallman Dr, Parker,CO.80134.....	02-24-84
Bothwell F J, B&B Supv., CN RY, 197 York St, London,ONT,Canada,N6A 1B3.....	09-16-90
Bradley J G, Asst Div Engr-Bridges, NS Corp, PO Box 14820, Knoxville,TN.37914.....	06-07-90
Bradley M L, Proj Engr, Conrail, 1335 Dublin Rd, Ste 112-A, Columbus,OH.43215.....	08-31-82
Brashares R E, B&B Supv, CSX Transportation, PO Box 414, Montgomery,AL.36101.....	09-11-69
Briggs D R, Proj Engr, KCS RY, 4601 Blanchard Rd, Shreveport,LA.71107.....	03-25-92
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Brooks, Jr, R L, Supv Strs, AT&SF RY, 1441 Airport Fwy, Euless,TX.76040.....	10-08-80
Broussard C T, AGM-Bus Dvlpmnt, LA & Delta RR, 402 W Washington, New Iberia,LA.70560.....	08-18-87
Bruestle K E, Dir Bridge Engr, BN RR, 9401 Indian Creek Pkwy-Rm 1500, Overland Park,KS.66210.....	09-07-83
Buchanan R S, Vice President, Apex Contracting Inc, 1608 Jackstown Rd, Paris,KY.40361.....	09-26-84
Buchko D E, Sr Cvl Engr, Enviroydyne Engineers Inc, 1308 Jill Terrace, Homewood,IL.60430-4046.....	09-17-75
Buckles D M, Iron Worker-Strl Steel, C&NW Trans Co, 1420 Crawford St, Boone,IA.50036.....	06-04-92
Budzileni J , Sr Strl Dsgnr (Ret), ICG RR, 1315 W Elmdale Ave, Chicago,IL.60660-2515.....	10-16-63
Burgel W D, Mgr, RY Engrn, BRW, Inc, 500 NE Multnomah St #860, Portland,OR.97232-2038.....	12-06-90
Burns B T, Structure Engr, AT&SF RY, 4515 Kansas Ave, Kansas,KS.66106.....	03-03-78
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Burrows F G, Cons'l Engr (Prof Of Engr), CA State U, 427 Bayside Rd, Apt B, Arcata,CA.95521.....	10-10-73
Burshiem J D, Gen Rdmsr, CP Rail System, 133 N Loop Rd, Savanna,IL.61074.....	01-06-93
Busboom G G, Sr Dsgn Tech, ESCA Consultants Inc, PO Box 159, Urbana,IL.61801.....	03-21-88
Busch L B, Associate, Horner & Shifrin Cnslt Engrs, 5200 Oakland Ave, St Louis,MO.63110-1436.....	08-31-77
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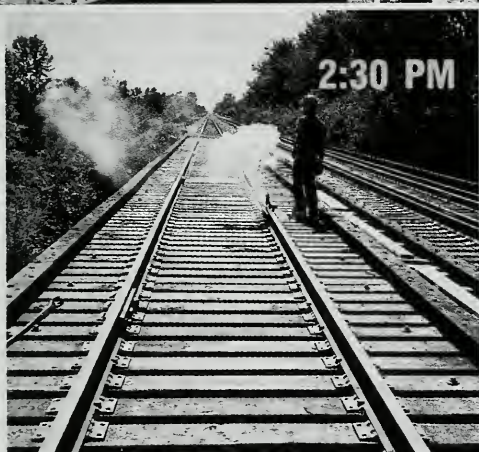


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Carrato J L, Asst VP, Alfred Benesch & Co, 205 N Michigan Ave, Chicago,IL.60601	09-30-88
Carter A B, Engr Of B&B, CSX Transportation, 63 Brakeman Dr, Stewartstown,PA.17363	03-31-77
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Carter, Jr J N, Asst Div Engr, NS Corp, PO Box 3070, Norfolk,VA.23514.....	10-20-86
Carver W, Supt M/W, Columbus & Greenville RY, PO Box 6000, Columbus,MS.39703.....	02-10-93
Cary D J, B&B Supv, Boston & Maine Corp, RR 1, Box 254, East Deerfield,MA.01342.....	12-05-91
Castrucci A, Sys Engr Strs-Fac, Conrail, 2001 Market St. 10-B-POB 41410, Philadelphia,PA.19101-1410.....	05-04-82
Catella T J, Chf Engr B&B, Boston & Maine Corp, Iron Horse Park, N Billerica,MA.01862	10-29-91
Cerny L T, Exec Dir, AREA, 50 F St NW Ste 7702, Washington,DC.20001	03-26-80
Chapin S J, Br Dsgn Engr, Hays, Seay, Mattern & Mattern, Po Box 13446, Roanoke,VA.24034	04-02-86
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Chopra S K, Engr Brs & Strs, CP Rail, Union Sta 65 Front St, Rm 366, Toronto,ONT,Canada,M5J 1E8.....	09-19-88
Choros J, Mgr Track Engr, AAR, 3140 S Federal St, Chicago,IL.60616.....	04-23-92
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Clark J A, Mgr-Const. Scheduling, UP RR, 1416 Dodge St, Rm 1000, Omaha,NE.68179.....	04-21-89
Clark M A, Dtlr-Str, NS Corp, 99 Spring St SW, Atlanta,GA.30303.....	08-17-88
Clark T H, Gen Supv Str, CSX Transportation, 2715 Ranier St, Florence,SC.29501	06-01-76
Clarke N, Bridge Inspector, CP Rail System, 120 Brookside Rd, Dalton,PA.18414	04-23-92
Clary D W, Mgr Material, NS Corp, 110 Franklin Rd SE, Roanoke,VA.24042-0072.....	04-26-88
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Corcoran R, Proj Engr, Amtrak, 210 S Canal St, Rm 410, Chicago,IL.60606	06-01-89
Costantino A A, Engr Of Trk, LI RR, Jamaica Station, Jamaica,NY.11435	08-24-84
Costigan J M, Asst B&B Supv, CN RY, 197 York St, London,ONT,Canada,N6A 1B3	03-25-92
Coventry K J, Chf Engr, Algoma Central RY, Box 7000, Sault Ste Marie,ONT,Canada,P6A 5P6.....	09-28-86
Covill C R, Asst Supv Strs, Conrail, 3520 Plumey Rd, Northwood,OH.43619	12-03-87
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Craine A S, Sr Strl Insp, Conrail, 2001 Market St, 10-B, Philadelphia,PA.19101-1410	09-16-90
Craighton J T, B&B Master, CP Rail, PO Box 4100, Agincourt,ONT,Canada,M1S 4A8	09-17-90
Criger L E, Mgr Civil Dept, Pritchard Corp, 10950 Grandview Dr, Overland Park,KS.66210	10-22-87
Culbertson B R, Mgr Of Strs, C&NW Trans Co, 900 Story St, Boone,IA.50036	09-20-87
Cunningham W P, Engineer, Missouri Cities Water Co, 18 Great Lakes Dr, St Peters,MO.63376-3226.....	08-12-81
Cyrus M A, Bridge Supv, Willamette & Pacific RR, 110 W 10th St, Albany,OR.97321	07-29-93
Daniel T, B&B Supv, NS Corp, 800 Princeton Ave, Bluefield,WV.24701	04-23-92
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Davids G A, Bridge Engr, FRA, 400—7th St SW (RRS-11), Washington,DC.20590	03-22-73
Davidson H L, Reg Mgr Of Gangs, CSX Transportation, PO Box 1500 Lynn Avenue, Corbin,KY.40701	08-14-86
Davis D R, Dir Of Ops, Atlanta & St Andrews Bay RY, PO Box 2775, Panama City,FL.32402.....	05-16-73
Davis G, Rdmstr, McCloud River RR, PO Box 1500, McCloud,CA.96057	06-07-90
Davis M, Engr B&B, Boston & Maine Corp, Iron Horse Park, N Billerica,MA.01862.....	03-21-93
Davis R R, B&B Supv, CP Rail System, 232 E Irving Park Rd, Wood Dale,IL.60191	02-17-82
Day F D, Sys Engr Strs Mice, Conrail, 2001 Market St-Rm 10-B, Philadelphia,PA.19101-1410.....	05-01-49
DeBerg D G, Asst Mgr-Rail, AT&SF RY, 1100 Clear Creek Rd, Kearney,MO.64060.....	10-04-82
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Ellison J, B&B Frmn, NS Corp, 11601 Co. Rd. 42 E, Jemison,AL.35085.....	10-18-79
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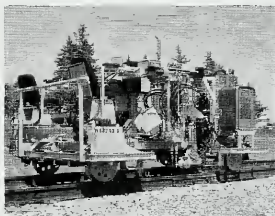
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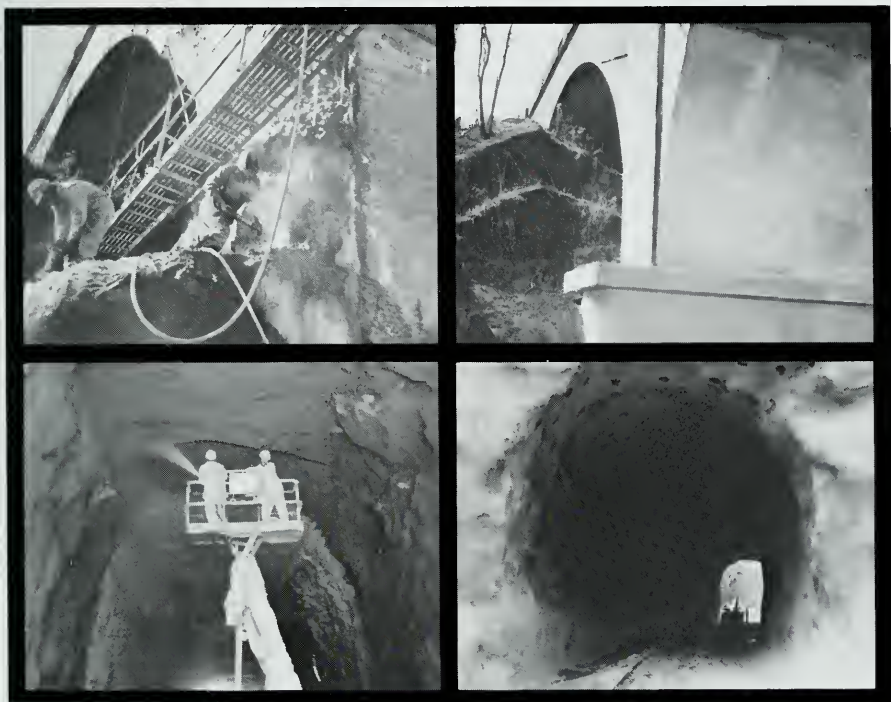
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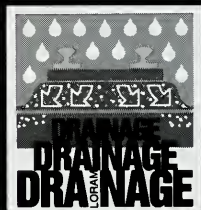


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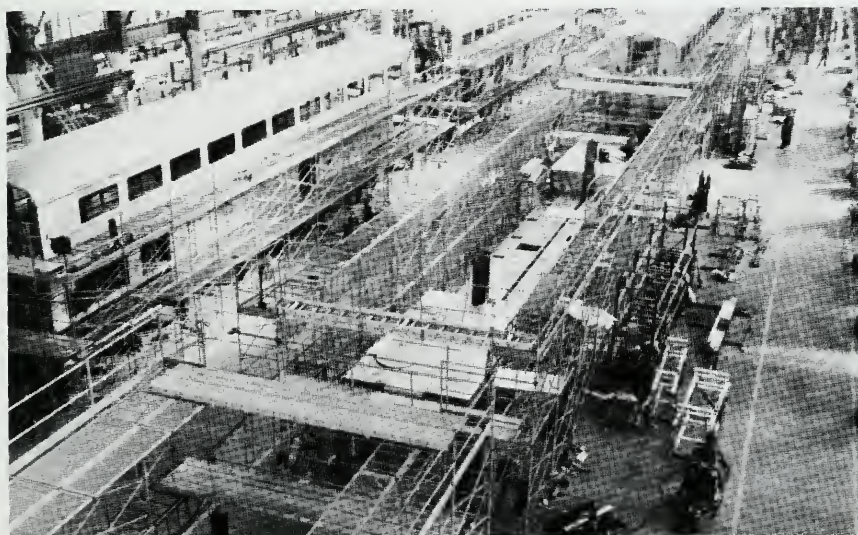
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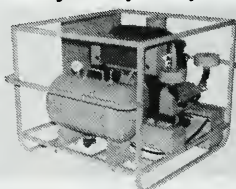
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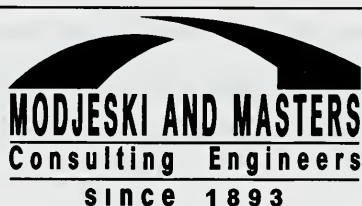
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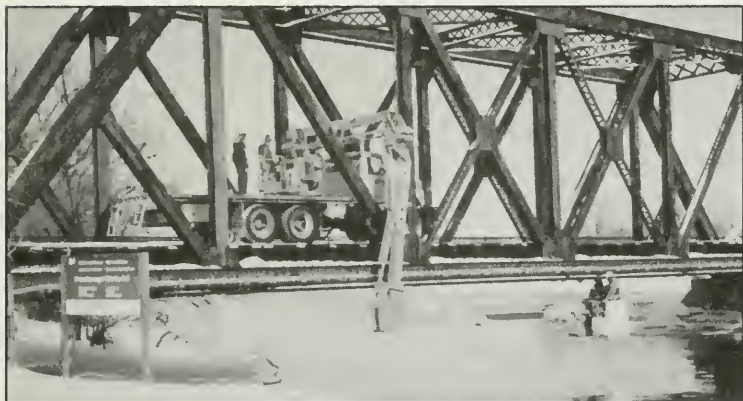
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